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**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

OCTOBER 1976

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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ENERGY

A Continuing Bibliography

With Indexes

Issue 11

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from July 1 through September 30, 1976 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OCTOBER 1976
Washington, D.C.

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(11)) lists 602 reports, journal articles, and other documents announced between July 1, 1976 and September 30, 1976 in *Scientific and Technical Aerospace Reports* (STAR) or in *International Aerospace Abstracts* (IAA). The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Five indexes—subject, personal author, corporate source, contract number, and report number—are included. The indexes are of the cumulating type throughout the year, with the fourth quarterly publication containing abstracts for the fourth quarter and index references for the four quarterly publications.

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A76-10000 Series)

All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies are available at \$5.00 per document up to a maximum of 20 pages. The charge for each additional page is 25 cents. Microfiche⁽¹⁾ are available at the rate of \$1.50 per microfiche for documents identified by the # symbol following the accession number. A number of publications, because of their special characteristics, are available only for reference in the AIAA Technical Information Service Library. Minimum airmail postage to foreign countries is \$1.00. Please refer to the accession number, e.g., (A76-10147), when requesting publications.

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GENERAL AVAILABILITY

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SUBSCRIPTION AVAILABILITY

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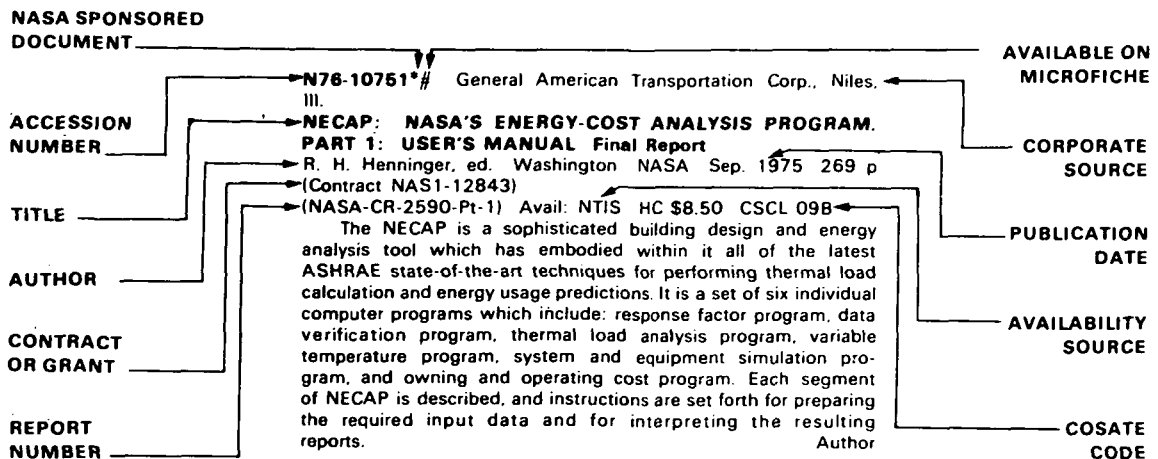
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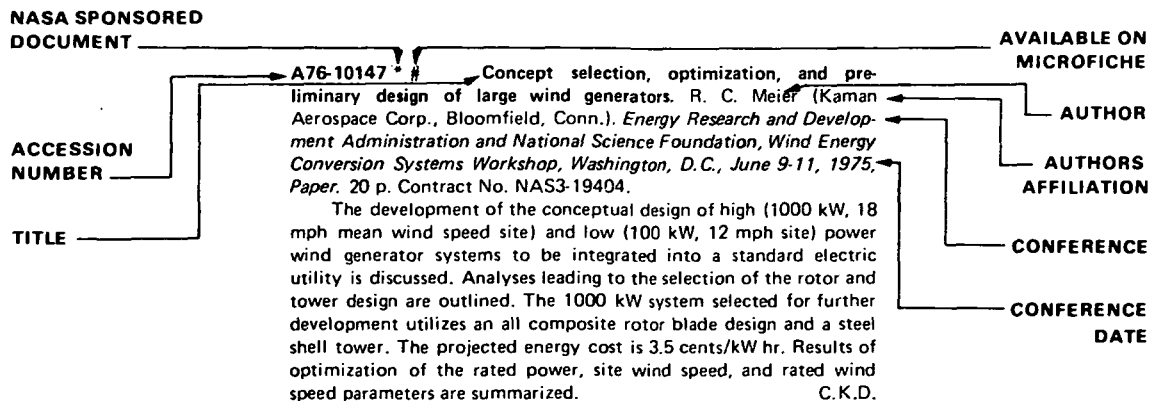
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TYPICAL CITATION AND ABSTRACT FROM IAA



A Listing of Energy Bibliographies Contained In This Publication:

1. Wind energy utilization, a bibliography with abstracts. Cumulative volume, 1944/1974
p0158 N76-23765
2. Quarterly literature review of hydrogen energy: A bibliography with abstracts, fourth
quarter 1975 p0159 N76-24697
3. World energy resources: An annotated bibliography of selected material on the availa-
bility and development of world energy resources p0171 N76-26699
4. Heat pipe technology. A bibliography with abstracts p0172 N76-27516

OCTOBER 1976

IAA ENTRIES

A76-28781 Problems of prediction and control in tidal energy. G. F. D. Duff (Toronto, University, Toronto, Canada). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings, Part 1. Pittsburgh, Pa., Instrument Society of America, 1975, p. 1.3 1-1.3 8. 14 refs.

Control and design problems for turbines and sluice gates are studied for the Bay of Fundy high-tide region. Tidal amplitude changes related to resonant length may be induced by barrier construction and may influence operating strategies. For optimization, finite classical models and continuous-parameter numerical models with one-dimensional coupled hydrodynamics are considered. The control problem for a double-basin triple-turbine system is also analyzed as it permits economies through internal pumping and storage, which can assist operations at low-amplitude tides. (Author)

A76-28805 On the dynamic optimization of tidal power plants. P. R. Bélanger (McGill University, Montreal, Canada) and W. Kerr (Canatom, Ltd., Montreal, Canada). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings, Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 2.3 1-2.3 8. 9 refs.

The method of Ritch (1973) for constrained optimal-control problems is applied to a tidal power plant. The plant equations and constraints are derived and set in normalized form. The resulting optimal-control problem is solved both for ideal efficiency and for prototype efficiency curves. A hundred-fold reduction in computing time is obtained over previous algorithms for this problem. (Author)

A76-28812 Multi-company electric power system control on the Pennsylvania-New Jersey-Maryland interconnection. C. F. Doll, M. H. Ewer (Philadelphia Electric Co., Philadelphia, Pa.), L. A. Schmidbauer, R. P. Whitesell (GPU Service Corp.), J. R. Evans (Pennsylvania Power and Light Co., Pa.), W. A. Johnson (Potomac Electric Power Co.), and C. B. Woodward, III. In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings, Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 17.1 1-17.1 16.

A presentation describing the use of digital computers for generation and transmission control employed by eleven electric power companies operated as a fully coordinated power pool. An introductory description of the power pool is provided along with an overview of the objectives and responsibilities of the pool and the participating member companies. Unique approaches taken by four of the member companies are described. Two of the company control systems were placed in service in 1973, one in 1974, and the fourth is scheduled for operation in 1976. Each presents a solution tailored to satisfy the requirements of an independent corporate entity and the responsibilities as a member of the multicompany coordinated power pool operation. (Author)

A76-28813 New roles for modern energy control centers. C. F. Ham (Houston Lighting and Power Co., Houston, Tex.). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings, Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 17.2 1-17.2 5.

The Energy Control Center (ECC) of the Houston Lighting and Power Company is described. The ECC is a multipurpose unit for dispatching electrical energy to meet fluctuations in consumer demand, monitoring and control of fuel supply and distribution, and monitoring of production levels and systems operations. The control system is based on two Sigma 5 computers, each of which has access to a 16 K work common core memory and a common drum bulk memory in addition to its 24 K work core memory and private drum bulk memory. Each computer has 48 general purpose registers, 32 levels of priority interrupts, 16 multiplexor input/output channels, and four real time clocks. The computers are interfaced with analog and digital telemetry. The operator consoles incorporate several types of displays, including four color cathode ray tubes, push button indicators, strip chart recorders and a graphite panel transmission map display. C.K.D.

A76-28814 New control system with an advanced man/machine interface for Commonwealth Edison Company's system security. T. C. Cihlar (Commonwealth Edison Co., Chicago, Ill.). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings, Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 17.3 1-17.3 9.

A control system for the supervision and management of the generation and transmission systems of an electric utility is described. A dual LN5500 computer system is maintained in a master-reserve state, with a data link and fail-over logic allowing control to be assumed by the reserve computer in the case of a failure in the master. Each of the two Sigma 5 computers has 48,000 words of memory, expandable to 64,000 words. All system programs are stored on rapid access data storage units and transferred as needed to the core memory. Data acquisition is by means of a dual digital system with analog back-up telemetry. Converted data are displayed by color cathode ray tubes, printers, mapboard, and recorders. In designing the man-machine interface, special attention was given to the elimination of non-pertinent data, resulting in the implementation of management by exception information display techniques. C.K.D.

A76-28815 The Ontario hydro data acquisition and computer system. J. W. Shelley (Rockwell International Corp., Anaheim, Calif.) and A. J. Harris (Ontario Hydro, Toronto, Canada). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings, Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 17.4 1-17.4 7.

A large Canadian electrical utility is nearing completion of a data-acquisition and computer system for the real-time monitoring of the operation of its bulk power system. It will be capable of accessing equipment status and electrical quantities from up to 200 transformer and generating stations every two seconds. The project involves an auxiliary power subsystem, a computer subsystem, a data-acquisition master station and remote terminal units, power

system instrumentation and control equipment, a communications network, security application programs subsystem, production and control application programs subsystem, and the man/machine subsystem. The paper outlines the management organization developed to implement the project. (Author)

A76-28816 Power system cybernetics and modern energy control centers. V. A. Venikov, B. I. Golovitsyn, and M. S. Liseev (Moskovskii Energeticheskii Institut, Moscow, USSR). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 24.1 1-24.1 7.

Problems confronted in developing control systems for large electric power systems are discussed, with special attention given to the selection of the amount and type of man-machine interaction. The state-of-the-art with regards to modeling and simulation techniques for power systems is reviewed, and the development of algorithms for real-time control is considered. The control system for the united national electric power system of the USSR is described. The hierarchical system provides control on local (individual power stations and substations), regional, and system-wide levels, and includes long-term (one month to one year) planning, short term (one day to one week) planning, automated real-time control, and automatic closed-loop control. Each control center is based on EC-1020-EC-1060 third generation computers. On the regional level 2 or 3 M-6000 computers are used in connection with one EC-1020. C.K.D.

A76-28817 System control in the Central Electricity Generating Board. J. W. Dillow, U. G. Knight, and J. Hewson. In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 24.2 1-24.2 9.

The development of system control facilities in the context of CEGB system characteristics is outlined. Present facilities are described. Two major developments are now in hand. One is an enhanced data transmission network which will provide improved access for operating staffs to local and central computing facilities and data banks; it will be used mainly for assembly of historic operating data and assessment of future system conditions. In the other hand, a large part of the existing analog telemetry system will be replaced by a digital system. Ergonomic aspects of the developments are mentioned. The paper concludes with a brief appraisal of possible future developments. (Author)

A76-28818 The new information system for the National Dispatching Centre at the Swedish State Power Board. L. Gustafsson and J. Lindqvist (Kungliga Valtenfallsstyrelsen, Vallingby, Sweden). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 24.3 1-24.3 8.

An account is given of the responsibilities of the Dispatch Centre with some background information about the power system. A derivation of the concept of the information systems functional design is presented. Reasons are given for the effort to get a high degree of integration and flexibility in the system. The system consists of a real-time part and an off-real-time part (planning and statistics). These are going to be integrated, and the two data bases will be fully compatible. Most of the report is devoted to the real-time part, which has a large input of on-line data from the power system. (Author)

A76-28819 Energy control centers in Japan - Evaluation of design principles and functions from security viewpoints. Y. Tamura (Waseda University, Tokyo, Japan), T. Yokoyama (Tokyo E. P. Co., Tokyo, Japan), A. Chiba (Chubu E. P. Co., Japan), T. Homma (Hokuriku E. P. Co., Japan), K. Kano (Kansai E. P. Co., Japan), K. Mitani (Kyushu E. P. Co., Japan), and K. Mizushima (Tokyo Shibaura Electric Co., Tokyo, Japan). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 24.4 1-24.4 12.

Features of energy control centers in Japan are introduced from the following angles: (1) configuration and function of computers in load dispatching offices, taking two examples of different nature to compare design philosophy, function sharing, and backup schemes; (2) relationship between load dispatching and switching operations, introducing two types of on-going projects: centralized-type where load dispatching and switching operations are issued in a unified hierarchy, and decentralized type where they are issued by two separate, but closely coupled, hierarchies; and (3) present status and future perspective of system operations from the security viewpoints. (Author)

A76-28820 Electrical dispatching in France - Status and trends. V. Saminaden (Electricité de France, Paris, France). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 24.5 1-24.5 9.

The nation-wide control system of Electricité de France is described. The system contains predictive functions to determine demand for long-term (5 years) and short-term (daily, weekly, annual) planning. Monitoring and supervisory control systems detect operational problems and transmit operator-initiated or automatic control commands to remote stations. Immediate control is provided by local protective equipment located in the remote stations. The telemetry system includes analog and digital pulse generator sensors. Each regional center is equipped with a scientific batch processing computer, a real-time computer, and an input-output real time lines device. Most of these computers have a 32 K words core storage. Data are displayed by black-and-white and color cathode ray tubes, digital indicators and strip chart recorders. Plans to upgrade the system, including development of new off-line programs using large computers, improvement of the telecommunications system, and installation of data acquisition computers in all centers, development of a remote control system configuration and out-stations automation, and reconfiguration of the national dispatching center, are outlined. C.K.D.

A76-28821 System identification for electric power systems. F. C. Schweppe (MIT, Cambridge, Mass.) and R. D. Masiello (Leeds and Northrup Corp., North Wales, Pa.). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 31.1 1-31.1 6. 11 refs.

A low order, linear identified model was developed and used to design a multimachine stabilizer. The parameter identification algorithm permits identification of individual elements of a system matrix description in a general physical form, and is related to maximum likelihood identification. The design process involves selection of weighting matrices on 22 states and 2 controls for use in solving the Riccati equation associated with the linear quadratic regulator problem. The nonlinear, high order simulation used to test the stabilizer describes two interconnected power systems with several generators each. The effect of simulated load disturbances was significantly decreased in the stabilized system. C.K.D.

A76-28822 Comparison of three different methods for statistical identification of the Italian power network. E. Canuto, D. Carlucci, G. Fiorio, R. Genesio, V. Mauro, and M. Milanese (Torino, Politecnico, Turin, Italy). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 31.2 1-31.2 11. 18 refs. Ente Nazionale per l'Energia Elettrica Grant No. CRA-18/74.

The identification of the Italian power network, which is interconnected within the European system, is examined. A simplified linear model is assumed, which approximates nonlinearities for small perturbations occurring under normal operating conditions. The load variations in different networks are assumed not to be correlated; cross correlations and cross spectral densities between networks are zero. Three identification methods are compared: spectral densities estimation and processing; a time domain method in which the maximum likelihood criterion is applied directly to measured quantities; extended Kalman filtering, in which the unknown parameters are modeled as states of a Markovian process. The first two methods are approximately equivalent in accuracy when used to estimate the parameters of networks with open or closed control loops. The third method is more useful than the others for on-line implementation. C.K.D.

A76-28824 Electrical power system load modelling by a two-stage stochastic approximation procedure. V. Panuska and J. P. Koutchouk (Concordia University, Montreal, Canada). In: International Federation of Automatic Control, Triennial World Congress, 6th, Boston and Cambridge, Mass., August 24-30, 1975, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1975, p. 31.4 1-31.4 7. 14 refs. National Research Council of Canada Grant No. A-7393.

This paper is concerned with developing a load model suitable for use with short-term forecasting techniques; the model comprises a periodic nominal load component, represented by a Fourier series, and a residual load component, represented by a general discrete linear stochastic difference equation. The method proposed achieves a separation of the components and identifies each using a stochastic approximation algorithm of the recursive least-squares type. The identification program form a part of a general interactive identification package which is also described. The results show a saving of an order of magnitude in both CPU-time and memory requirements.

(Author)

A76-28899 Geothermal energy technology assessment. P. N. Cheremisinoff (New Jersey Institute of Technology, N.J.) and A. C. Morresi (Exxon Research and Engineering Co., Linden, N.J.). Westport, Conn., TECHNOMIC Publishing Co., Inc., 1976. 171 p. 125 refs. \$20.

An overview of technology currently available for development of systems utilizing geothermal energy is presented. The distribution and character of known sources of geothermal energy are considered, and exploration and drilling techniques are described. The design of different types of geothermal power production systems, including dry steam electrical systems, wet steam systems, hot water heat exchanger systems, and hot rock systems, is discussed. Applications of geothermal energy and the environmental impact of widespread use of geothermal energy are examined. C.K.D.

A76-29186 Theoretical study on the performance of horizontal parabolic cylinder type collector for solar cooling. M. Udagawa and K.-I. Kimura (Waseda University, Tokyo, Japan). *Heat Transfer - Japanese Research*, vol. 4, Oct.-Dec. 1975, p. 1-22. 10 refs. Translation.

The possibility of cooling a house with solar energy by means of a horizontal parabolic cylinder type solar collector combined with an absorption refrigeration device utilizing a lithium bromide absorber is studied theoretically. The setting, the shape of the parabola, and the collector area required to achieve a temperature level of 100 deg C are investigated. Simulation studies show that several kinds of

parabolic cylinder collectors with 32.4 sq m total collecting area used in combination with a 1 RT absorption refrigerator, and operated from 9 a.m. to 3 p.m. during July and August, are capable of providing solar cooling for 10-30% of the time in Tokyo and about 60% of the time in Naha.

C.K.D.

A76-29273 # Energy and physics (Energija i fizika). P. L. Kapitza (Akademii Nauk SSSR, Institut Fizicheskikh Problem, Moscow, USSR). *Uspekhi Fizicheskikh Nauk*, vol. 118, Feb. 1976, p. 307-314. 6 refs. In Russian.

Text of lecture delivered by the author on world energy problems from the standpoint of physics to Oct. 8, 1975 meeting marking the 250th anniversary of the Academy of Sciences. Laws governing and restricting density of energy flow and transformation of energy from one form to another are reviewed. Limitations and disadvantages of various schemes for transforming energy, including nuclear energy, wind power, biophysical processes, solar and geothermal energy, and hydraulic power via damming and utilization of tides, are discussed. Some optimism is expressed in regard to harnessing geothermal and thermonuclear energy. R.D.V.

A76-29572 Oil and gas from coal. N. P. Cochran (ERDA, Demonstration Plants Div., Washington, D.C.). *Scientific American*, vol. 234, May 1976, p. 24-29. 5 refs.

An exploitation of the U.S. huge reserves of coal in connection with the problems of the energy crisis will depend on the development of a technology that will convert coal into oil and gas on a large scale. The principles of the technology already exist. However, it will be necessary to mobilize the financial and industrial resources which are needed to put the technology on a commercial basis. A description is given of four basic processes for producing oil from coal, taking into account carbonization, hydrogenation, extraction, and the Fischer-Tropsch synthesis. The most successful commercial operation may possibly be one that involves a combination of processes. Details concerning such an operation are discussed. G.R.

A76-29579 United States uranium resources - An analysis of historical data. M. A. Lieberman (California, University, Berkeley, Calif.). *Science*, vol. 192, Apr. 30, 1976, p. 431-436. 16 refs.

It is pointed out that practically the entire amount of high-grade uranium ore in the U.S. occurs in the sedimentary sandstone and mudstone deposits of the Colorado Plateau, the Wyoming Basins, and the Gulf Coastal Plain of Texas. Objective estimates are discussed of the ultimate recoverable uranium resources which are available from the western sandstone deposits. Attention is given to a classification by forward cost, discoveries per foot of exploratory drilling, cumulative production and discoveries, and higher cost categories of uranium ore. The available uranium resources are found to be only one-third of those estimated by the Energy Research and Development Administration. It is predicted that a serious uranium supply problem will develop during the late 1980s if the expansion of nuclear electric power proceeds as planned. G.R.

A76-29725 Fluid mechanics applied to water treatment and energy problems (Mécanique des fluides appliquée aux problèmes aménagement et d'énergétique). Edited by M. Hug (Electricité de France; Ecole Nationale des Ponts et Chaussées, Paris, France). Paris, Eyrolles, Editeur, 1975. 1208 p. In French. \$88.60.

An encyclopedic handbook on practical aspects of fluid mechanics. Topics covered include: basic physical properties of fluids and general equations, similitude and dimensional analysis, laminar and turbulent flow, incompressible boundary layer theory, ideal inviscid fluids, turbulence, probabilistic models of the open sea and swells, offshore structures, waterway transportation, cavitation, hydraulic machinery, fluid flow and environmental studies, municipal hydraulics and hydrology, two-phase flow systems, stability of flow patterns, design of continuous heat exchangers, subterranean hydraulics (including oil reservoir hydraulics), and fluid mechanics measurements. R.D.V.

A76-29750 Science and technology for energy - Problems and perspectives (Science et technologie pour l'énergie - Problèmes et perspectives). Paris, Organisation de Coopération et de Développement Economiques, 1975. 273 p. In French. \$8.75.

An analysis is presented of the problems and trends in scientific and technical research programs in the field of energy production. The changing role of fossil fuels in the international energy economy is discussed, and the development of synthetic hydrocarbon fuels is considered. Progress in the development and implementation of nuclear energy and of solar, geothermal, and wind energy systems is outlined. The technology associated with the production, storage, and transport of electricity, methanol, and hydrogen is described. An extensive analysis of the role of political and economic factors in the energy research and development programs in member countries of the Organisation de Coopération et de Développement Economiques is given. C.K.D.

A76-29804 Effect of energy shortage and land use on auto occupancy. J. Behnam (Marquette University, Milwaukee, Wis.) and R. E. Beglinger (Wisconsin Department of Transportation, Milwaukee, Wis.). *ASCE, Transportation Engineering Journal*, vol. 102, May 1976, p. 255-270. 5 refs. Research sponsored by the U.S. Department of Transportation.

A research project is described which is oriented toward the examination of the relationship of automobile occupancy rate to land-use characteristics and sensitivity of occupancy rates to the change in fuel prices that took place in 1973, on the basis of 4-yr data on the Milwaukee metropolitan area. The study attempts to determine the factors that would be helpful in increasing occupancy rates on the freeway system. Major conclusions are that the occupancy rates were generally significantly increased during the peak of energy shortage and high fuel prices, that the commuting population was sensitive to travel cost for a short period and was alarmed by the fuel shortage, that the land-use characteristics of the area were influential factors as determinants of the occupancy rates, and that these rates were independent of time and no consistent trends were observed for the period of study. The occupancy rates declined to the levels which were experienced prior to the fuel crisis after the motoring public became more acclimated to the increased cost of gasoline and recognized the increase in availability of energy. S.D.

A76-29865 # The effect of the fuel crisis on the acceleration of technical progress in aviation (Wplyw kryzysu paliwowego na przyspieszenie postępu technicznego w lotnictwie). J. Staszek. *Technika Lotnicza i Astronautyczna*, vol. 31, Mar. 1976, p. 8-10. In Polish.

The article surveys the general features of the recent international fuel crisis, the history of projections of fuel needs and reserves, trends in fuel utilization in various branches of industry, and ways of rendering fuel consumption in aviation more efficient. The possible contributions of turboprop and turbofan engines, high bypass ratios, narrowing of compressor frontal cross sections, improvements in labyrinth seals, modification of combustion chambers, minimization of compressor and turbine pressure losses, and improved cooling of turbine blades are discussed, along with improvements in fan performance, improved thermal insulation of turbine blading, improved engine bearings, faired cowlings, and the use of laminate composite blades in fans and compressors. Fuel consumption by different types of aviation engines is compared. Justification of social policy on the use of fuel to transport small numbers of privileged individuals is raised for question. R.D.V.

A76-30101 Annual review of energy. Volume 1. Edited by J. M. Hollander (California, University, Berkeley, Calif.). Palo Alto, Calif., Annual Reviews, Inc., 1976. 804 p. \$17.

Questions concerning energy supply and distribution are considered, taking into account the production of high-Btu gas from coal, clean liquids and gaseous fuels from coal for electric power, the nuclear fuel cycle, solar energy, geothermal energy, the prospects of a utilization of oil shale, nuclear fusion, waste materials, hydrogen

energy, aspects of energy storage, and advanced energy conversion processes. The impacts of energy on environment, health, and safety are examined, giving attention to the social and environmental costs of energy systems, the health effects of energy production and conversion, and the economic costs of energy-related environmental pollution. Other subjects discussed are related to energy and the economy, energy conservation, energy policy and politics, and the international aspects of energy.

G.R.

A76-30102 Energy in our future. H. Brown (California Institute of Technology, Pasadena, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 1-36. 39 refs.

The growth of human energy demand from the time of the emergence of man to the present era is examined and a fissioning of human society into two quite separate and distinct cultures is considered. The described developments have led to critical situations concerning the supply of the energy and the food which are needed. Attention is given to the life expectancy of petroleum and natural gas in the U.S. and in the world, the availability of alternative energy resources, questions of energy pricing, and future energy demands and the approaches which can be used to satisfy these demands. G.R.

A76-30103 Coal - Energy keystone. R. A. Schmidt and G. R. Hill (Electric Power Research Institute, Palo Alto, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 37-63. 29 refs.

It is pointed out that over the past three decades the electric utility industry has become the largest consumer of coal in the U.S. This industry consumes now about two thirds of the present total national production of coal. An investigation is conducted concerning the possibility to base the satisfaction of the energy requirements of the electric utility industry also in the future on a utilization of the national coal resources. Aspects related to the quantity and quality of coal resources and reserves are examined and the approaches used for extracting and preparing coal are considered. Attention is given to questions of transportation and distribution, the external effects of coal production, and the factors which constrain the development of the coal industry. G.R.

A76-30104 Production of high-Btu gas from coal. H. R. Linden, W. W. Bodle, B. S. Lee, and K. C. Vyas (Institute of Gas Technology, Chicago, Ill.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 65-85.

About one third of the total energy requirements of the U.S. has been met in recent years by a use of natural gas. Problems related to inadequate natural gas supplies can possibly be solved with the aid of high-Btu gas which can be produced from extensive U.S. coal supplies. The fundamental reactions for coal gasification are examined and the general aspects of gasification systems are considered. Approaches for the upgrading of the raw gas are discussed. A description is given of specific gasification processes, taking into account the Lurgi technique, the HYGAS pilot plant, the carbon dioxide acceptor process, the Synthane process, and a process which converts coal to gas and oil products. G.R.

A76-30105 Clean liquids and gaseous fuels from coal for electric power. S. B. Alpert and R. M. Lundberg (Electric Power Research Institute, Palo Alto, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 87-99.

Clean fuels from coal are needed for electric power production because of environmental concerns and dwindling supplies of domestic oil and gas. The approaches available to provide these fuels are examined. Methods of coal liquefaction currently being studied

are to improve the processes used in Germany during World War II. Large-scale, high-capacity plants operating at about 100 atmospheres are being considered. Methods for coal gasification are also discussed, taking into account fixed-bed programs, entrained gasification programs, and fluid-bed programs. G.R.

A76-30106 The nuclear fuel cycle. E. Zebroski and M. Levenson (Electric Power Research Institute, Palo Alto, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 101-130. 29 refs.

The nuclear power capacity and its growth in the U.S. and in the entire world are considered. Aspects of fuel performance in light-water reactors are examined, taking into account mechanical performance, effects of fuel defects, and the behavior of fuel in postulated loss-of-coolant accidents. An investigation of nuclear power costs is conducted, giving attention to the economic performance of fuel, capital cost, and productivity. Approaches for radioactive waste disposal are discussed along with questions related to the provision of safeguards for fissile materials. G.R.

A76-30107 Solar energy. F. H. Morse (Maryland, University, College Park, Md.) and M. K. Simmons (California, University, Berkeley, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 131-158. 101 refs.

The characteristics of the solar energy received on the surface of the earth are examined and a description is given of the status of the technologies available to utilize this energy for human energy requirements. Applications of solar energy related to the heating and cooling of buildings appear to be closest to commercialization. Solar thermal conversion methods employing sunlight focusing devices make it possible to obtain very high temperatures. The challenge in the development of photovoltaic technology is to produce arrays that can be used on an economically competitive basis. Approaches utilizing natural collection processes of solar energy are also discussed, taking into account a utilization of wind energy, bioconversion, and ocean thermal conversion methods. Attention is given to the economics of solar energy and its environmental impact. G.R.

A76-30108 Geothermal energy. P. Kruger. In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 159-182. 58 refs.

Geothermal resources suitable for commercial exploitation are defined as localized geologic deposits of heat concentrated at attainable depths, in confined volumes, and at temperatures sufficient for electric or thermal energy utilization. The various types of geothermal resource are considered along with the exploration methods and the resource potential. Factors involved in resource extraction are discussed, taking into account drilling technology and aspects of reservoir engineering. Resource utilization is related to the development of electric power conversion systems and suitable techniques for thermal energy utilization. Attention is also given to economic factors, environmental factors, legal factors, and a national geothermal program. G.R.

A76-30109 Oil shale - The prospects and problems of an emerging energy industry. S. Rattien (NSF, Washington, D.C.) and D. Eaton (Johns Hopkins University, Baltimore, Md.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 183-212. 47 refs.

An analysis is conducted concerning the energy potential of the oil shale, taking into account total shale oil resources, recoverable reserves, commercially exploitable reserves, mining methods, retort processes, problems of waste shale disposal, in situ technology, the costs of oil shale production, economics of nuclear in situ retorting, and aspects of oil shale profitability. Environmental and developmental issues are also considered, giving attention to aspects of air pollution connected with a commercial shale oil industry, effects of the operations on the water quality, and problems to obtain the water for supporting the industry. It is concluded that a commercial

shale oil industry is clearly feasible. However, substantial uncertainty exists regarding a number of significant factors. G.R.

A76-30110 Nuclear fusion. R. F. Post (California, University, Livermore, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 213-255. 14 refs. Contract No. W-7405-eng-48.

It is pointed out that the achievement of controlled nuclear fusion would offer the best long-term solution to the energy-related problems of mankind. The basic fusion reactions are examined and the quantitative requirements for fusion power are considered, taking into account the Lawson criterion and the problems of plasma pressure and fusion power density. The scientific issues for fusion power in the case of the magnetic confinement process and the pellet fusion approach are discussed. A description is provided of fusion experiments and aspects of fusion technology. Attention is given to magnetic fields, vacuum and wall technology, high-energy neutral beams, high-power lasers, and techniques for direct electrical conversion. G.R.

A76-30111 Waste materials. C. G. Golueke and P. H. McGauhey (California, University, Richmond, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 257-277. 65 refs.

Information concerning the amount of various types of waste is presented and an estimate is given of the energy available in the waste materials, taking into account municipal waste, the domestic fraction of municipal wastes, industrial wastes, agricultural wastes, and mining. A description is provided of the technology available for converting wastes into energy. Thermal systems are discussed, giving attention to combustion systems, incineration operations, the use of refuse as a supplementary fuel, the direct utilization of hot gases, and pyrolysis and pyrolysis-combustion systems. Biological systems and solar energy waste conversion systems are also considered. G.R.

A76-30112 Hydrogen energy. D. P. Gregory and J. B. Pangborn (Institute of Gas Technology, Chicago, Ill.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 279-310. 40 refs.

Approaches for the utilization of nuclear, solar, geothermal, wind, tide, and biological energy sources are frequently associated with a conversion of the primary form of energy into electric energy. However, an all-electric economy has a number of disadvantages. On the basis of the reported investigation, it is concluded that hydrogen energy has as great a potential for application as does electrical energy, with which it should usually be compared as an alternative. The development of mixed hydrogen-electric energy system after the year 2000 is thought to be a likely possibility. Attention is given to hydrogen production methods, hydrogen transmission, approaches for hydrogen storage, and aspects of hydrogen utilization. G.R.

A76-30113 Energy storage. F. R. Kalhammer (Electric Power Research Institute, Palo Alto, Calif.) and T. R. Schneider (Public Service Electric and Gas Co., Newark, N.J.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 311-343. 137 refs.

Major opportunities for new applications of energy storage are in electric utility systems, transportation, the residential/commercial sector, and the utilization of solar energy. A description is provided of the methods and technologies of energy storage, taking into account mechanical energy storage, thermal energy storage, chemical energy storage, and superconducting magnetic energy storage. Batteries, involving a form of chemical energy storage, qualify for the broadest range of energy storage applications on the basis of prospective performance and operational characteristics. G.R.

A76-30114 Advanced energy conversion. E. V. Somers, D. Berg (Westinghouse Electric Corp., Pittsburgh, Pa.), and A. P. Fickett (Electric Power Research Institute, Palo Alto, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif.,

Annual Reviews, Inc., 1976, p. 345-368. 97 refs.

Open combined-cycle gas-turbine power plants are considered along with closed-cycle gas-turbine power plants, magnetohydrodynamic power plants, potassium-steam binary-cycle power plants, low-temperature closed-cycle power plants, and fuel-cell power plants. The fuel cell converts chemical energy directly to electrical energy, avoiding the Carnot cycle limitation of thermal machines. This results in the potential of an overall efficiency above 50%. Attention is given to the low-temperature aqueous fuel cell, the molten electrolyte fuel cell, and the solid-oxide electrolyte fuel cell.

G.R.

A76-30115 The energy industry and the capital market. W. E. Pelley, R. W. Constable, and H. W. Krupp (Bankers Trust Co., New York, N.Y.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 369-389. 14 refs.

An investigation is conducted concerning the capital requirements of the U.S. energy industry through 1990. The energy demands in the case of the various consuming sectors are examined and the supply of energy and its capital costs are considered. Attention is given to the balancing of fuel supply and demand, external financing requirements, and the state of the capital market. It is found that the energy industry will require only 21.7% of the supply available in the capital markets. It is pointed out that the ability of the industry to obtain its share of the capital market will depend on industry's attractiveness to the investing groups which compose that market.

G.R.

A76-30116 The price of energy. D. E. Sander (New York State Public Service Commission, Albany, N.Y.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 391-421. 65 refs.

Historic departures from efficient prices are considered, taking into account preferences which the oil industry has enjoyed under the federal income tax laws, aspects of cartelization, the restriction of foreign oil imports, the promotion of natural gas demand, the pricing of coal, and the distribution of electricity and gas. Important energy price issues are discussed. Attention is given to issues of deregulation, the incremental pricing of electricity, and the significance of adjustment clauses.

G.R.

A76-30117 Energy system modeling and forecasting. K. C. Hoffman (Brookhaven National Laboratory, Upton, N.Y.) and D. O. Wood (MIT, Cambridge, Mass.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 423-453. 66 refs.

This review provides an introduction to the scope, applications, methodology, and content of energy system models, particularly those developed and used in the United States. A classification of models is presented, and representative models are discussed. Three levels of planning are considered: policy planning, strategic planning, and tactical or operational planning. Energy system models provide support at all three planning levels, for regulatory agencies; for industrial planning, management, and evaluation of R&D programs; and for national energy policy and strategy planning. The objectives of these planning activities and the requirements imposed on the models are discussed. The trend of current research is toward developing models that integrate engineering/process models with more behavioral models to form energy/economic systems that treat the demand for and supply of energy types simultaneously with those for other factors of production. This approach should result in a substantial improvement in both the forecasting and the descriptive power of the resulting models.

S.D.

A76-30118 Raising the productivity of energy utilization. L. Schipper (California, University, Berkeley, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 455-517. 156 refs. ERDA-supported research.

A comparison of the amount of energy consumed per dollar of gross national product in different industrialized and emerging countries and an examination of the energy used in different U.S. cities show that energy consumption may be reduced by increasing the efficiency of energy use without a significant effect on the standard of living. The first- and second-law efficiencies of a variety of processes are examined. An economic analysis indicates that conserving 30-40% of the expected future total energy demand by designing buildings and engineering industrial processes for energy efficiency would be less expensive than producing the equivalent amount of energy. Nontechnical barriers, including defects in the pricing of energy, control of the end use of energy, and time needed for society to adjust to rising energy costs, are discussed in detail.

C.K.D.

A76-30119 Potential for energy conservation in industry. C. A. Berg. In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 519-534. 5 refs.

The range of technical contributions that would be required in a research effort for conservation of fuel in the field of specialized ferrous heat-treating to improve metal properties is discussed. It is shown that natural gas should be eliminated as a basis for endothermic furnace atmospheres. In the case where combustible furnace atmospheres are used, they should also be used as fuel. High-temperature heat recuperation can be used to save fuel, and heat-treating plants might be concentrated into larger facilities to permit the use of high-temperature flue gas heat for power generation. There is also the possibility to switch heat treating to electric furnaces. If this could be combined with use of inert gas furnace atmospheres, it would be possible to conduct heat-treating operations using coal or nuclear power as the primary energy source. The present differentiation of equipment suppliers stands as a major constraint upon the rate at which new heat-treating processes and new equipment systems might be introduced to facilitate adjustment of the industry to the rapidly changing situation of energy supply and price.

S.D.

A76-30120 Social and institutional factors in energy conservation. P. P. Craig (California, University, Berkeley, Calif.), J. Darmstadter (Resources for the Future, Inc., Washington, D.C.), and S. Rattien (NSF, Washington, D.C.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 535-551. 19 refs.

The status of energy conservation activities is discussed as related to the forces that shape the demand for energy, the historic relationship between energy use and GNP and the questionable inexorability of this relationship, the framework in which to view energy conservation, recent trends in energy conservation, various strategies for encouraging conservation, and future expectations. The discussion identified the factors that have historically discouraged energy conservation, the changes that have occurred in the recent past, and the opportunities for encouraging energy conservation in the years ahead. Economic forces are likely to play a major role in spurring conservation, but there is need for governmental action to overcome a number of marketplace problems such as lack of information, inadequate research and demonstration, failure to account for problems of resource depletion, adverse environmental effects of energy supply and use, limited capital availability, and difficulties in balance of payments and national security.

S.D.

A76-30121 Social and environmental costs of energy systems. R. J. Budnitz and J. P. Holdren (California, University, Berkeley, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 553-580. 42 refs. ERDA-sponsored research.

Environmental and social costs cover a wide spectrum of concerns - e.g., occupational safety, public health, economic productivity, environmental diversity, social stability, and each policy or action produces a different mix of impacts and costs. A distinction is made between impacts, meaning disruptive influences exerted on the

physical and social environment, and costs, meaning measures of the response of the environment to these influences. The discussion covers types of impacts and costs and methods for assessing particular impacts and costs of specific energy technologies. A prominent feature of the discussion presented is the apparent inadequacies in most of the methodologies now available for detailed analysis of environmental impacts of energy technologies. The available data suggest the possibility of significant interference in critical environmental processes, as well as direct effects on human health. S.D.

A76-30122 Health effects of energy production and conversion. C. L. Comar (Electric Power Research Institute, Palo Alto, Calif.) and L. A. Sagan (Palo Alto Medical Clinic, Palo Alto, Calif.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 581-600. 41 refs.

Following discussions of some basic principles in consideration of health effects, available data on health effects are presented for fuel extraction, transport, processing, and electricity generation from major fuel systems with emphasis on the main uncertainties and controversies. Particular attention is devoted to exposure-response relationships, risks of death, and health effects from electricity generation as related to fossil fuels and nuclear power (high- and low-level effects). Despite the uncertainties of the numerical values involved, they are of interest as a starting point in thinking about what risks society is willing or not willing to accept in order to avoid the acknowledged technical difficulties of handling nuclear power and the chance of catastrophe, or to avoid the biological effects of inadequate electricity. S.D.

A76-30123 Economic costs of energy-related environmental pollution. L. B. Lave (Carnegie-Mellon University, Pittsburgh, Pa.) and L. P. Silverman (National Academy of Sciences, Washington, D.C.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 601-628. 143 refs. Grant No. PHS-5-R01-HS-01529.

A large body of literature on the economics of environmental pollution is reviewed, with particular reference to pollution resulting from energy use. An economic theory of the market is outlined, incorporating environmental considerations and the problems of exhausting natural resources. The theory and methods of benefit-cost analysis is reviewed, applying the underlying concepts to determine the cost of venting residuals into the environment. The specific effects of venting residuals into air and water and on land are evaluated relative to the social costs of effluents. Public policy goals and strategies with respect to environmental management are discussed. An illustrative analysis is presented for the fuel cycle costs of electricity generation with alternative fuels. The rapidly growing theoretical literature on exhaustible resources emphasizes the need for empirical investigations of resources that are presumably exhaustible, e.g., iron ore. More empirical evidence is necessary on the efficiency and equity effects of alternative regulatory strategies. S.D.

A76-30124 Safety of nuclear power. J. M. Hendrie (Brookhaven National Laboratory, Upton, N.Y.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 663-683. 17 refs.

The degree of safety associated with power production by different types of nuclear power plants and with the processing and storage of radioactive wastes is assessed. Nuclear power plant designs incorporate redundant and overlapping safety control systems to guard against component failures and malfunctions. Additional safety systems and special design features are included to minimize the consequences of a wide range of hypothesized design basis accidents and extreme natural phenomena. The categories and consequences of possible failures in water-cooled reactor systems, high-temperature gas-cooled reactor plants, and liquid-metal-cooled fast breeder reactor plants are examined. Probability studies have shown that the chance of core meltdown in a water-cooled system is about 1 in 20,000 years of operation and that 99% of such accidents would involve no direct fatalities. The probabilities associated with compa-

able accidents in the other systems are expected to be similar. The consequences of a successful sabotage attempt would be at worst comparable to the effects of major accidents. C.K.D.

A76-30125 Energy self-sufficiency. P. L. Auer (Cornell University, Ithaca, N.Y.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 685-713. 37 refs.

The long and short term goals of Project Independence, a federal program for the development of energy self-sufficiency, are discussed. The history of federal policy regarding the regulation of energy resources and prices is reviewed. The Project Independence report and recommendations regarding the future balance of energy supply and demand is compared with the study conducted by the Energy Policy Project of the Ford Foundation. Government policy directing the distribution of funds for energy research and development is examined in detail. C.K.D.

A76-30126 Energy regulation - A quagmire for energy policy. W. O. Doub (LeBoeuf, Lamb, Leiby and MacRae, Washington, D.C.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 715-725.

Recent attempts by the Administration and Congress to formulate and implement a national energy policy with the goals of reducing U.S. dependency on energy imports, guarding against disruption of foreign supplies, increasing conservation and efficiency, and enhancing domestic energy supplies are discussed. The evolution of federal policy regarding the regulation of energy production and utilization and energy prices is outlined. The allocation of responsibility and authority in energy-related matters between the state and federal governments is examined together with the recommendations resulting from the Federal Energy Regulatory Study. C.K.D.

A76-30128 International energy issues and options. M. Willrich (Virginia University, Charlottesville, Va.). In: Annual review of energy. Volume 1. Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 743-772. 26 refs.

An analysis of the world energy situation from a political viewpoint is conducted. A description is given of the international political structure as it relates to the evolving world energy situation. The relation between energy and national security is examined for energy-importing and energy-exporting countries. The key energy issues for an evolving world economy are considered, taking into account the economic efficiency of energy use, the role of energy in economic development, the role of private multinational corporations in the energy sector, and the management of the financial aspect of the international oil trade. The impact of energy-related activities on the global environment is also discussed. G.R.

A76-30224 Energy recovery from municipal solid waste and method of comparing refuse-derived fuels. H. P. Sheng and H. Alter (National Center for Resource Recovery, Inc., Washington, D.C.). *Resource Recovery and Conservation*, vol. 1, May 1975, p. 85-93. 15 refs. NSF-supported research.

It is shown that a plant processing municipal solid waste to separate magnetic metals, aluminum, other non-ferrous metals, glass, and a fuel fraction consisting of most of the organic material in the waste, can produce from about 4 to 13 times more electrical energy than it consumes (assuming 28 percent conversion efficiency of fuel to electricity). The utility, and hence value of the fuel produced will depend on its moisture and ash contents. The effect of these latter two properties on decreasing the available energy in the fuel is examined. The fraction of the fuel produced needed to dry the remainder is calculated and shown graphically for different values of the heat of combustion and efficiency of drying. (Author)

A76-30227 A thermochemical process for hydrogen production. K. F. Knoche, H. Cremer, and G. Steinborn (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *International Journal of Hydrogen Energy*, vol. 1, Jan. 30, 1976, p. 23-32.

An iron-chlorine closed thermochemical process for hydrogen

production is presented, and the mass and energy flows of the process are discussed in detail. The process may be used as a 1 bar cycle or as a 40 bar cycle which operates on about the same pressure level as the coolant for a high-temperature gas-cooled reactor. Iron (II)-chloride is reduced by hydrogen, and the resulting iron is hydrolysed by steam to give iron (II, III)-oxide. Oxygen produced by the reverse Deacon process oxidizes this oxide to iron (III) oxide. Both oxides (II, III; III) are chlorinated with hydrochloric acid. The resulting chloride is vaporized and decomposed. The overall efficiencies are 42.4% for the 1 bar cycle including electricity generation and 41.8% for the 40 bar cycle. C.K.D.

A76-30228 The photosynthetic production of hydrogen. G. Neil, J. O. Bockris, J. F. McCann (South Australia, Flinders University, Adelaide, Australia), and D. J. D. Nicholas (Adelaide, University, Adelaide, Australia). *International Journal of Hydrogen Energy*, vol. 1, Jan. 30, 1976, p. 45-48. 9 refs.

A systematic investigation of photosynthetic hydrogen production using a blue-green alga, *Anabaena cylindrica*, has been carried out. The results indicate that there are two important problems which must be overcome for large-scale hydrogen production using photosynthetic processes. These are the development of a stable system and attainment of at least a fifty-fold increase in the rate of hydrogen evolution per unit area illuminated. (Author)

A76-30229 Energy transmission systems. G. G. Leeth (GE Center for Advanced Studies, Santa Barbara, Calif.). *International Journal of Hydrogen Energy*, vol. 1, Jan. 30, 1976, p. 49-53. 5 refs.

Various methods of transporting large quantities of energy are compared. The energy source is assumed to be nuclear fission. However, expected significant effects of alternative energy sources are noted. The associated energy distribution system is essentially ignored. The procedure consists of evaluating several different thermal, chemical, and electrical energy forms. Basically, the evaluation is a technical and economic comparison including capital costs and energy loss costs. Additional qualitative evaluation is accomplished by listing significant features of the various energy modes. Results indicate that hydrogen is superior to all forms of energy transport considered. An EVA-ADAM chemical heat pipe system. (Bohn et al., 1974) is intermediate between hydrogen and electricity or hot water. High-voltage electric overhead transmission and hot water are the most expensive systems. In addition, for the case of a large energy center, all of the pipeline methods of energy transport are superior to electric transmission from the viewpoints of heat rejection and the 'getaway' problem. (Author)

A76-30231 The place of new energy sources in future growth schemes (La place des énergies nouvelles dans les futurs schémas de croissance). J.-C. Colli. *Revue Française de l'Electricité*, vol. 48, 4th Quarter, 1975, p. 6-11. In French.

A report to the French Ministry of Industry and Research has predicted that by 1985 nuclear energy will provide 25 percent of the total energy needs of France. An additional 2 percent is expected to be provided by new energy sources, including solar, geothermal, and wind energy and energy obtained from biological sources. A brief review is given of the advantages and limitations of these sources and of current and predicted applications of different types of energy in France. C.K.D.

A76-30251 System energy in high speed ground transportation. J. Y. Wong. (Arizona State University, *International Conference on High Speed Ground Transportation*, Tempe, Ariz., Jan. 7-10, 1975.) *High Speed Ground Transportation Journal*, vol. 9, Spring 1975, p. 307-320. 20 refs. Research supported by the National Research Council and Defence Research Board of Canada.

The transport efficiency of a tracked air cushion vehicle and a magnetically levitated vehicle is evaluated in terms of a criterion defined as the ratio of transport productivity (product of payload and operating speed) to the corresponding power input of the transportation system. This criterion - which takes the speed of transportation into account - provides a common basis for evaluating

the technological performance of various systems with differing speed characteristics. It is shown there is a distinct speed range within which the tracked air cushion vehicle would have higher transport efficiency than that of the vehicle system employing vehicle-borne superconducting magnets and conducting roadbed. Owing to magnetic drag, it is economical to operate the magnetically levitated vehicle only within a rather limited speed range. Within the speed range of 250-300 mph, the power consumption per unit transport productivity of these two systems is of the same order of magnitude as that of subsonic jet aircraft cruising at nearly twice the speed. S.D.

A76-30254 Energy demand and consumption requirements for solid-state controlled linear induction motor propulsion systems. F. L. Raposa (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). (Arizona State University, *International Conference on High Speed Ground Transportation*, Tempe, Ariz., Jan. 7-10, 1975.) *High Speed Ground Transportation Journal*, vol. 9, Spring 1975, p. 345-353. 6 refs.

The electrical energy requirements of linear induction motor propulsion systems controlled by different power conditioners are studied. The energy requirements for the various modes of acceleration, cruise, and deceleration are determined. Three cases are considered: variable voltage controlled system, variable frequency controlled system with phase control, and variable frequency controlled system with pulse width modulation. It is shown that implementation of various techniques of solid-state power control (power conditioning) has significant impact on the electrical energy requirements. The variable frequency controlled system with pulse width modulation is potentially the most energy efficient system. Power conditioners of this type require advanced technologies to make their size and weight effective. S.D.

A76-30257 Energy regeneration and conversion efficiency in a hydraulic-hybrid propulsion system. P. H. Wojciechowski (Rochester Institute of Technology, Rochester, N.Y.) and H. S. Dunn (Swarthmore College, Swarthmore, Pa.). (Arizona State University, *International Conference on High Speed Ground Transportation*, Tempe, Ariz., Jan. 7-10, 1975.) *High Speed Ground Transportation Journal*, vol. 9, Spring 1975, p. 383-392. 12 refs. Research supported by the Alliance Tool and Die Corp.; NSF Grant No. GK-30096.

A regenerative hybrid system is proposed in which a small energy storage capacity is combined with a medium-sized prime mover, the minimum rating of which depends on design criteria and mission of the particular vehicle. The energy is stored by compressing gas inside the bladder of a hydraulic accumulator. The proposed hybrid design employs a parallel system in which the prime mover directly powers the vehicle during cruise or steady-state operation while the stored energy system provides power, either exclusively or in parallel with the prime mover, during acceleration. Data from laboratory tests are presented to indicate achievable energy conversion efficiencies. Computer simulation of various size vehicles being driven over typical transit-vehicle schedules is used to evaluate the reduction in vehicular emissions and energy consumption resulting from the energy storage capability. The technical advantages of the proposed system are noted. S.D.

A76-30270 Energy and transportation in Canada and the United States. J. Lukasiewicz (Carleton University, Ottawa, Canada). *High Speed Ground Transportation Journal*, vol. 9, Fall 1975, p. 151-174. 32 refs. Research supported by the Department of Energy, Mines and Resources and National Research Council of Canada.

The consumption of fuel oil in the U.S. and Canadian transportation systems is analyzed, and fuel savings are evaluated which could be realized by using more economical cars and by a partial shift of automobile, air, and truck traffic to railroads. The feasibility of electrifying the entire North American rail system is examined, and data are presented which indicate that intercity railways will not be able to compete successfully with other transportation modes until extensive modernization of the U.S. and

Canadian rails is accomplished. The quality of rail service in North America, Western Europe, and Japan is compared; major deficiencies in the current regulation of Canadian railways are identified, and it is suggested that new legislation is a necessary first step in the modernization of North American rail transport. It is concluded that savings on the order of 57% in oil consumption can be realized through the redistribution of traffic to the rails, railway electrification, more economical cars, and the use of electric cars and trucks for short-distance hauls. F.G.M.

A76-30271 **Reduction of energy consumption in high-speed ground transportation.** J. V. Foa (George Washington University, Washington, D.C.). *High Speed Ground Transportation Journal*, vol. 9, Fall 1975, p. 175-180. 9 refs.

The propulsion energy demands of land vehicles may be reduced significantly, at speeds at which aerodynamic forces are an important component of the drag, through a mechanism resembling some that have been considered in the past in connection with aeronautical applications. This mechanism combines boundary-layer control with the utilization of boundary-layer air in the generation of thrust. The feasibility and potential advantages of this mode of propulsion appear to be far greater in land than in air transportation. (Author)

A76-30272 **Pneumatic tube transportation.** C. M. Harman (Duke University, Durham, N.C.) and J. J. Cudlin (Babcock and Wilcox Co., Lynchburg, Va.). *High Speed Ground Transportation Journal*, vol. 9, Fall 1975, p. 181-189. 26 refs.

Results of basic research on the pneumatic-tube system are used to project significant operating characteristics of a prototype pneumatic-tube transportation system. The projections are based on an experimentally verified and numerically computed analysis as well as laws of similitude. Background and other pneumatic-tube studies are noted. Vehicle speed variations on the guideway, due to air friction and compressibility during a transit are shown for the prototype double-tube system to be acceptable at moderate speeds. Guideway power is shown to be strongly affected by average vehicle speed, to be essentially directly proportional to guideway discharge pressure, and to be little influenced by vehicle weight. The technical feasibility of the investigated features of the concept is supported. (Author)

A76-30275 **Development of a high-tower solar heat/light-concentrating system for generation of electric power.** K. Fukuda, H. Higuchi, M. Ogasawara, and K. Yanagi. *Mitsubishi Juko Giho*, vol. 13, no. 1, 1976, p. 42-49. In Japanese, with abstract in English.

A solar energy acquisition and conversion system based on a high tower with heat- and light-concentrating mechanisms is designed for generation of electric power. Equipment includes: a heliostat with sun-tracking mechanism, an array of mirrors, heat absorbers, selectively transparent membranes (film) and selectively absorbing surfaces. System flowcharts are presented, and specifications are given on mirror size, mirror spacing, and arrangement of the mirror array for optimum solar energy concentration. Calculations of light concentration, collected light energy, mirror utilization efficiency, heat concentrated, sun tracking accuracy, tower height effects, heat flowrate distribution in heat absorber, and system efficiencies are reported. About 75% of the solar energy incident on the system at summer solstice can be collected on the heat absorber, and conversion efficiency (to heat at 400 C) is 80%. R.D.V.

A76-30281 **Semitransparent tin-oxide films on Pyrex plates - Measurements of reflectivity.** G. Redaelli (Centro Informazioni Studi ed Esperienze, Milan, Italy). *Applied Optics*, vol. 15, May 1976, p. 1122, 1123. 22 refs.

The heat-reflecting properties of tin oxide films are examined for possible SnO₂ applications in trapping solar radiation. Transmission of visual radiation combined with high reflectance of infrared is required. Reflectance spectra of Sb-doped stannic oxide films on heat-stable glass were taken. Reflectivity is found to increase with thickness and sheet conductance. Doped and undoped layers of

similar absorptivity showed significant differences in reflectivity, implying that doped SnO₂ layers would trap solar radiation more efficiently. The stannic oxide films are highly resistant to attack by acids and bases, and do not peel readily. R.D.V.

A76-30356 **The role of petroleum liquids and gas in U.S. energy supply over the next 25 years.** A. R. Tussing (Alaska, University, Fairbanks, Alaska). *Professional Engineer*, vol. 46, Apr. 1976, p. 18-20.

On the basis of economic considerations it is concluded that the U.S. will continue to depend principally upon oil and natural gas, in particular, imported crude oil, over the next 25 years. It is pointed out that, except for coal, other prospective energy sources face huge technical, economic, environmental, and/or institutional uncertainties. Approaches of U.S. domestic energy policy should emphasize energy conservation, the discovery and development of conventional oil and gas, and conversion of electrical generating plants and industrial boilers from oil and gas to coal. G.R.

A76-30357 **ERDA's coal program for combustion, liquefaction, MHD, gasification.** R. C. Seamans, Jr. (ERDA, Washington, D.C.). *Professional Engineer*, vol. 46, Apr. 1976, p. 21-23.

The U.S. Energy Research and Development Administration (ERDA) has the objective to double U.S. coal consumption by 1985. An implementation of this objective requires the development of technologically superior approaches to mine, transport, and utilize coal. ERDA's coal-related R and D program is discussed. Attention is given to direct combustion, coal liquefaction and gasification, in situ technology, and advanced power systems. New systems based on the principles of magnetohydrodynamic promise efficiencies in the range from 50 to 60%. G.R.

A76-30358 **Synthetic fuels - An industry struggles to be born amidst the perils of 'techno-econo-politics'.** M. Heyman. *Professional Engineer*, vol. 46, Apr. 1976, p. 26-29. 8 refs.

The term 'synthetic fuels' generally refers to the production of gas and liquid fuels derived from coal and oil shale. However, fuels from municipal and agricultural wastes are now also considered. Categories of synthetic fuels are related to utility and industrial fuels, synthetic petroleum, and high Btu gas. It is predicted that the demand for synthetic fuels in 1995 will be the equivalent of five million barrels of oil per day. The recommendations of a federal multiagency task force concerning the development of synthetic fuels are considered. Attention is given to the response from industry, the opposition of house members, the optimistic attitude of ERDA officials, and arguments regarding an inclusion of shale oil in the synthetic fuel program. G.R.

A76-30359 **Nuclear power station technology - Crucial strand in U.S. energy lifeline.** R. W. Roberts (ERDA, Washington, D.C.). *Professional Engineer*, vol. 46, Apr. 1976, p. 30-33.

Current programs for the development of nuclear power are examined, taking into account the vital need to expand the nation's uranium enrichment capabilities and the objectives of the Nuclear Fuel Assurance Act of 1975. ERDA is committed to the concept of the breeder approach as a next step in the nuclear energy option for commercial power production. The liquid metal fast breeder considered is to provide a greatly enhanced uranium fuel utilization. The breeder offers a long-term solution to the continued generation of low-cost electrical power. A key demonstration project for electrical power generation in a utility environment by a liquid metal fast breeder is planned. G.R.

A76-30360 **The future of nuclear power - A policymaker's dilemma.** G. E. Brown, Jr. (U.S. House of Representatives, Committee on Science and Technology, Washington, D.C.). *Professional Engineer*, vol. 46, Apr. 1976, p. 37-39.

The characteristics of nuclear powered economy and of an energy system based on coal combustion are critically examined, taking into account a number of undesirable features inherent in both technologies. It is concluded that a serious historical mistake

has been made when the energy options were narrowed down to those which exist at the moment. A future energy policy should be concerned with a set of choices which can suit the varied needs of particular segments of the world community under a range of future conditions which at the present time cannot yet be accurately predicted. G.R.

A76-30364 The future of transportation in Britain. R. Marsh (British Railways Board, London, England). *High Speed Ground Transportation Journal*, vol. 9, Summer 1975, p. 1-12.

Transportation is a key factor in the solution of serious problems related to the rapid urbanization which takes place in Britain. The role of railroad transportation within the national transportation system is considered. The existing rail system and its performance are examined and a description is given of plans for a modernized railway which will provide improved transportation service for the transportation of passenger and freight. The introduction of a new generation of high-speed trains in 1975 is to be followed by the Advanced Passenger Train in the early 1980s. It is pointed out that by 1981 well over half of Britain's train mileage will be electrified. Questions concerning the energy consumption of various modes of transport are also discussed. G.R.

A76-30367 The energy crisis and intercity passenger transportation. H. S. Norton (South Carolina, University, Columbia, S.C.). *High Speed Ground Transportation Journal*, vol. 9, Summer 1975, p. 51-58, 10 refs.

Developments in intercity passenger transportation during the period from 1935 to 1970 are examined, taking into account the decline of railroad passenger traffic. An investigation is conducted concerning the possibilities for a reestablishment of the railroad as a major factor in intercity passenger service. It is found that the role of the railroad must probably be confined to trips in the range from 500 to 1000 miles between heavily populated areas. For the considered intermediate distances, rail can be superior to either air or bus with respect to elapsed time when downtown-to-downtown movement is considered. G.R.

A76-30400 # Experimental investigation of a heat pipe for solar devices (Eksperimental'noe issledovanie teplovoi trubki dlia solnechnykh ustanovok). O. Mukhammetdurdyeva, K. Toiliiev, R. Bairamov, and I. P. Vasilenko (Turkmenkii Gosudarstvennyi Universitet, Ashkhabad, Turkmen SSR). *Akademii Nauk Turkmenkoi SSR, Izvestiia, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 6, 1975, p. 108-110. 5 refs. In Russian.

Efficient transfer of heat energy is readily and inexpensively achieved by means of heat pipes characterized by simple design, light weight, absence of moving parts, and operational reliability. Experiments are carried out to study the characteristics of a heat pipe made of stainless steel and having the following parameters: total length = 400 mm, diameter = 14 mm, wall thickness = 1 mm. The pipe contains a 0.4-mm-thick porous wick. Since solar radiation density is not high (0.03-0.1 W per sq cm) and the heat pipe in solar devices may be arranged in a horizontal position or at a positive angle of inclination (about 30 deg), the capillary structure may be represented by a fine-cell network made of stainless steel. Water is chosen as the most suitable heat carrier over the given temperature range of 20-100 C. It is shown that the temperature distribution along the pipe up to the condensation zone is almost uniform, the temperature drop along the pipe being 3 to 5 deg. The temperature distribution along the pipe for different temperatures of coolant in the condenser is discussed. S.D.

A76-30412 Results of an experimental investigation of the dissipation of energy in the mixing chamber of the injector-accelerating device of an MHD generator. V. I. Kuznetsov (Moskovskii Aviatsionnyi Institut, Moscow, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 13, July-Aug. 1975, p. 836-842.) *High Temperature*, vol. 13, no. 4, Jan. 1976, p. 756-761. 7 refs. Translation.

The energy losses in the mixing chamber of a steam-water injector are determined. The losses arise from the interaction of the two-phase flow with the chamber walls. Two injectors differing in the method of cold water supply are investigated, and graphs showing the dependence of the coefficient characterizing the energy losses on the injection coefficient are plotted for each injector type. V.P.

A76-30422 Effect of the preheating temperature of the products of the thermochemical treatment of the fuel on the thermal efficiency of MHD electric power plants. A. P. Rogachev, A. G. Sokol'skii, and B. Ia. Shumiatskii (Akademii Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 13, July-Aug. 1975, p. 902-904.) *High Temperature*, vol. 13, no. 4, Jan. 1976, p. 829-831. Translation.

A76-30545 Fusion-fission hybrid concepts for laser-induced fusion. J. Maniscalco (California, University, Livermore, Calif.). *Nuclear Technology*, vol. 28, Jan. 1976, p. 98-107. 16 refs. ERDA sponsored research.

Fusion-fission hybrid concepts are viewed as subcritical fission reactors driven and controlled by high-energy neutrons from a laser-induced fusion reactor. Blanket designs encompassing a substantial portion of the spectrum of different fission reactor technologies are analyzed and compared. More promising hybrid concepts can be subjected to in-depth studies that treat the engineering, safety, and economic requirements as well as the neutronic aspects. It is demonstrated that fusion-fission hybrids can be designed to meet a broad spectrum of fissile-breeding and fusion-energy-multiplying requirements. The neutronic results should prove to be extremely useful in formulating the technical scope of future studies concerned with evaluating the technical and economic feasibility of hybrid concepts for laser-induced fusion. (Author)

A76-30574 Modern energy technology. Volumes 1 & 2. Edited by M. Fogiel. New York, Research and Education Association, 1975. Vol. 1, 959 p.; vol. 2, 861 p. Price of two volumes, \$34.50.

The papers deal with energy sources (other than oil) that are most promising from the point of view of development time, cost, pollution effects, and availability in quantities sufficient to meet future demands. The various problems involved in developing new technologies to provide the increasing amounts of clean energy required by the world population are examined. Technologies associated with nuclear power; coal; natural gas; oil shale; solar, geothermal, and hydrogen fuel cells; and organic wastes are treated in detail. V.P.

A76-30625 # Some future trends in aero engine design for subsonic transport aircraft. A. J. B. Jackson (Rolls-Royce /1971/, Ltd., Derby, England). (*American Society of Mechanical Engineers, Gas Turbine Conference, Houston, Tex., Mar. 2-6, 1975, Paper 75-GT-2*.) *ASME, Transactions, Series A - Journal of Engineering for Power*, vol. 98, Apr. 1976, p. 281-289. 7 refs.

The problems presented to the aero engine designer by the decreasing world oil and aviation fuel supplies and by noise and pollution regulations are discussed. It is shown that a key parameter for subsonic transport aircraft is specific fuel consumption. The propulsive efficiency element in specific fuel consumption is considered in detail. Some of the technical parameters which will influence the choice of specific thrust (bypass ratio) in the next generation of engines are examined, including installation standard, engine weight, cruise to take-off thrust ratio, and engine noise. The effect of specific thrust on direct operating costs and payload range is discussed. It is concluded that potential gains in direct operating costs and payload range will come primarily from means other than increasing propulsive frequency by reduction of specific thrust. C.K.D.

A76-30640 Some factors characteristic of transport vehicles (Su alcuni fattori caratteristici dei veicoli da trasporto). G. Gabrielli (Torino, Politecnico, Turin, Italy). In: In honor of Carlo Ferrari. Turin, Libreria Editrice Universitaria Levrotto e Bella, 1974, p. 255, 257-270. In Italian.

The paper studies the role of three dimensionless factors in the behavior of different types of transport vehicles. These are: (1) the ratio of propulsive force per unit of total weight to maximum horizontal velocity; (2) the ratio of transportation capacity to energy utilization (fuel consumption); and (3) the ratio of total vehicle weight at the beginning of the trip to the weight of cargo. Tables are presented containing values of these ratios for different types of vehicles including automobiles, trains, ships and aircraft. B.J.

A76-30800 Energy resources are not all fuel reserves. D. Ion. *New Scientist*, vol. 70, Apr. 29, 1976, p. 222-224.

The fraction of the supposed worldwide coal resources which are proved reserves, recoverable from known, defined deposits under current economic and operational conditions is examined. Various estimates of the world's energy reserves and resources are compared, and the main energy resources that might be available in practice in the 1990's are estimated. It is concluded that the portion of the world's coal resources that can be classified as proved reserves at this time is not greatly in excess of the known reserves of crude oil expressed in coal equivalents. The proved reserves of uranium are critically low (1 Mt) in comparison with projected demands (4.5 Mt for thermal reactors only by 2000). C.K.D.

A76-30824 # Astronautics - As a key to the earth's energy problems (Astronautyka - Energetyce ziemskiej). M. Subotowicz. *Astronautyka*, vol. 19, no. 1, 1976, p. 3-10. In Polish.

The article presents a preliminary review of work on the feasibility of tapping inexhaustible and pollution-free energy sources, centering on satellite solar power stations but also treating fusion power. Weight, size, power delivery, power transmission and storage, and cost estimates are cited for solar-cell power stations in geostationary synchronous orbits beaming energy to earth at microwave frequencies. The size of the orbiting energy-collecting antennas, microwave hardware (amplifiers and klystrons) and photovoltaic cells, advantages and drawbacks of surface solar stations in unpopulated desert areas, planar wire mesh microwave reflectors in orbit, the effect of space power antenna sidelobes on the earth's radiation budget, the effect of high-power microwave radiation on humans, birds, aircraft, aviation and maritime radar communications in the path of orbit-earth beams are considered. Orbiting costs, assembly in orbit, placement in orbit to minimize geographical longitude drift, and possible applications of Space Shuttle in the program are mentioned. The outlook for economical exploitation of fusion power, aided by laser implosion to generate plasmas, is also discussed. R.D.V.

A76-30900 Residential solar heating. W. Hapgood and W. Teich (Raytheon Co., Microwave and Power Tube Div., Waltham, Mass.). *Electronic Progress*, vol. 18, Spring 1976, p. 19-25.

The basics of solar heating of houses and solar hot water heating are outlined, along with a practical application for a model home and the economic payback derived therefrom. A solar heating system consists of four sections: heat collection, heat storage, heat distribution, and backup heat provided by an auxiliary electric heating equipment. Particular attention is given to the design types of solar collectors. Unlike conventional heating systems where oversizing the equipment carries a minimum penalty, an oversized solar heating system is totally uneconomical. Implementation and performance of a residential solar heating system are discussed, where the collectors are drained when the sun is not shining in order to protect against freezing. The solar hot water heating system is similar in concept to the space heating design; however, it is used for tap water and has valving to connect and disconnect the service water from the collectors. Conventional and solar heating costs are discussed. S.D.

A76-30916 # Technical progress in the design of aircraft from the standpoint of fuel economy (Postep techniczny w budowie samolotow w aspekcie oszczednosci paliwowych). J. Staszek. *Technika Lotnicza i Astronautyczna*, vol. 31, Apr. 1976, p. 19-22. In Polish.

Reliance on supercritical airfoil profiles, vortex diffusers, boundary layer suction, active control (of control surfaces), and new materials to reduce the size and weight of passenger airliners and cargo aircraft without penalties in performance is reviewed. Supercritical profiles bring about greater L/D ratios which, with increased wing span, are more effective in reducing induced drag than is the use of vortex diffusers. But vortex diffusers mean a smaller moment arm at the wing root, and only 0.5% increase in bending moment as against 8.5% caused by increased wing span. Boundary layer control through air suction by slits add up to 30% fuel savings. Properly selected flexible elastic BLC coating can reduce drag friction by 50%. Active control of control surfaces means less static stability, but greater indifference to gusts and flutter. Fiber (glass, boron, graphite) reinforced materials (resins, metals) add strength while reducing weight. Fuel savings up to 35% are predicted for the next generation of airliners, and as much as 55% for the next generation of cargo aircraft. R.D.V.

A76-30922 On-line simulation of solar systems heating. A. H. Eltimsahy (Toledo, University, Toledo, Ohio) and C. H. Copass (Carnegie-Mellon University, Pittsburgh, Pa.). *Simulation*, vol. 26, May 1976, p. 155-161. 5 refs.

This paper deals with the programming of a minicomputer system which is connected to a small solar heating system to create a model of a larger solar heating system. The program enables the computer to serve as an on-line control and real-time data collection system. The small solar heating system is heavily instrumented to provide dynamic input data to the computer. The output of the computer program simulates the operation of a much larger solar heating system. This combination of software with the hardware has proven to be a broadly useful research tool for solar-heating investigations. This paper describes both aspects of the simulation model. (Author)

A76-31100 Microwave power - A 'far-out' system. W. N. Agosto (Microwave Semiconductor Corp., Somerset, N.J.). *IEEE Spectrum*, vol. 13, May 1976, p. 48-50.

Beaming of solar energy to earth via microwave systems from space-orbiting solar power stations is reviewed briefly. Closed-cycle helium turbogenerators fired by solar concentrators are rated far higher in efficiency (40% even in the earth environment) than solar cell panels (18% efficiency), but their weight (10 kg/kW) imposes a severe launch penalty. Attention is given to possibilities of mining satellite power station raw materials and fabricating satellite power station structures on the moon, with much lower launch costs and weight problems. Costs of space solar power stations and rectifying cell power-beaming antennas ('rectennas') and power systems needed to meet energy needs of coming decades are estimated. Microwave high-power transmission techniques and likely microwave hardware for the job are discussed. Biological and ecological effects of high-power microwave beams are mentioned, but considered minor. R.D.V.

A76-31152 # On transmission improvement for automotive gas turbines. V. Maizza (Bari, Università, Bari, Italy). In: Associazione Italiana di Meccanica Teorica ed Applicata, National Congress, 2nd, Naples, Italy, October 16-19, 1974, Proceedings. Volume 3. Milan, Associazione Italiana di Meccanica Teorica ed Applicata, 1974, p. 415-426. 7 refs.

It was thought difficult for an automobile with gas turbine engine to provide accelerations comparable to engine-transmission systems now in use. Examples are given of performance curves and fuel economy for both single-shaft and two-shaft turbines equipped with different transmission types. A single-shaft gas turbine is proposed which, in particular operative stages, can benefit from a transmission group which includes a continuously variable drive and a polyphase torque converter employing mercury which can be

utilized as flywheel. This group has both considerable torque conversion capacity and a high kinetic energy accumulating possibility which can offer better accelerations in a wider output speed range. (Author)

A76-31376 * Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Conference sponsored by University of Alabama, NASA, AIAA, ERDA, et al. Edited by S. T. Wu, D. L. Christensen, R. R. Head (Alabama, University, Huntsville, Ala.), and W. E. Whitacre (NASA, Marshall Space Flight Center, Huntsville, Ala.). Huntsville, Ala., UAH Press, 1975. 653 p. \$25.

Topics related to architectural and institutional considerations are discussed along with studies of components and subsystems. Subjects in the area of system design and analysis are also explored. Residential and commercial applications are considered, taking into account hot-water usage in a typical single-family residence, solar heating and cooling of mobile homes, aspects of design and performance in the case of a solar heating system using a reflective pyramid optical condenser, solar heating in a Boston school, a performance analysis of solar service hot water systems, comparative performance analyses of three solar heated and cooled buildings, and the use of solar energy in a soybean processing operation. Applications related to power generation are also examined, giving attention to solar thermal electric power systems and photovoltaic research.

G.R.

A76-31377 The UAH solar and wind energy program. D. L. Christensen (Alabama, University, Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 3-14.

Research and design studies of the described program include an environmental analysis concerning the available energy from solar and wind sources and preliminary feasibility studies to investigate the combination of solar and wind energy conversion systems for applications related to buildings, mass transit systems, and grain drying processes. A description is given of the facilities for experimental studies. A small solar panel test stand has been designed and constructed which will simultaneously compare various materials and coatings for their characteristics regarding the absorption and emission of solar energy. Another test stand is intended for the study of high-temperature solar concentration systems.

G.R.

A76-31378 * Status of Marshall Space Flight Center solar house. W. R. Humphries (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 15-30.

The Marshall Space Flight Center (MSFC) solar facility is described herein, and test results obtained from late May 1974 to September 1974 are discussed. This facility was assembled to provide operational experience in the utilization of solar energy for heating and cooling buildings. The major subsystems are the solar collector, the energy storage tank, the simulated living space, the air conditioning and heating subsystems, and the controls. These subsystems are described with emphasis placed on major results and conclusions. A cursory evaluation of the system for cooling is given from energy and power consumption viewpoints. This data evaluation indicates the current system is capable of supplying 50 per cent of the thermal energy required to drive the air conditioner. A preliminary evaluation of winter data indicates that more than 90 per cent of the heating required can be provided by the solar system. (Author)

A76-31379 * Activities in space-based solar power development. W. E. Whitacre (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 31-41.

Two space-based power concepts are considered. The satellite

solar power system concept employs a large solar cell array to convert solar energy to electrical energy. The energy, in the form of microwaves, is transmitted to the ground where it is converted to dc power and transmitted to the utility network. According to the power relay satellite concept, power is generated on the ground at large stations in remote areas. The generated power in the form of microwaves is beamed for distribution to a relay satellite. Studies related to an investigation of the feasibility of the two concepts are briefly discussed. G.R.

A76-31380 Architectural constraints on solar applications to housing. D. Watson (Yale University, Guilford, Conn.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 89-102. 7 refs.

The architectural constraints considered are related to climate, solar technology capability, competitive fuel costs, the building type, and market factors. Architectural requirements of housing are examined, taking into account a design study which was undertaken to investigate what percentage of collector area might be reasonably incorporated into a house design. Attention is also given to collector cost, efficiency, and architectural constraints. G.R.

A76-31381 Economic aspects of solar energy in the Southeast. M. C. Ziemke and C. A. Ponder (Chrysler Corp., Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 103-111. 9 refs.

Attention is given to the early major use of solar energy, building energy requirements, architectural considerations, and aspects of competition from improved conventional building energy systems. An analysis regarding the economic feasibility of solar energy in the Southeast is conducted. It is found that only the cheaper solar energy systems will be able to compete with the expected TVA power rates of 1985. If an improved heat pump is used with the anticipated high 1985 utility rates, solar power appears economically competitive at \$5000 and 9% interest rates. G.R.

A76-31382 Environmental exposure considerations in solar heating and cooling systems. H. H. Yen and D. R. Reese (Wyle Laboratories, Inc., Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 113-119.

In view of the high investment costs in connection with the installation of a solar heating and cooling system in a home or building, a decision concerning the use of such a system might depend on the costs of system operation over long periods of time. In an examination of problem areas, it is seen that the collector and the associated plumbing is the part of the system which is most vulnerable to extreme conditions regarding the environmental factors. An investigation of possible environmental effects is conducted, taking into account temperature extremes, humidity, sand and dust, snow, wind, rain, seismic effects, solar radiation, air pollution, ice, hail, and freezing rain. G.R.

A76-31383 Outdoor performance testing of flat-plate solar collectors. G. A. Zerlaut and W. T. Dokos (Desert Sunshine Exposure Tests, Inc., Phoenix, Ariz.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 121-140.

Equations for the determination of flat-plate collector efficiency are considered along with initially used experimental test procedures related to the control of water flow, temperature measurements, wind velocity measurements, and insolation measurements. A description is given of a collector test facility which was designed to minimize certain problems encountered in the initial investigations. The test facility makes use of a 500-gal, gravity-feed, water tank. Specification testing involving a use of the test facility is discussed.

Attention is given to various problems of outdoor testing, taking into account approaches for overcoming these problems. G.R.

A76-31385 Predicted performance of transparent plastic honeycomb solar collectors. R. K. Wedel and K. N. Marshall (Lockheed Research Laboratories, Palo Alto, Calif.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 157-170. 9 refs. NSF Grant No. C-956.

A study is presented on the use of transparent plastic honeycombs in flat plate solar collectors for improvement of efficiencies at elevated temperatures (180 to 240 F). The honeycomb concept is discussed, and the advantages of using transparent honeycomb are presented. The theory used to analyze the honeycomb collector systems is discussed. For five transparent plastics, the single film measured radiation properties are given. From the measured data the effective emittances of the honeycomb were calculated. Finally, predicted efficiencies for honeycomb systems are given for various honeycomb aspect ratios and absorber plate coatings. Comparisons are made between the different honeycombs and with other designs. (Author)

A76-31386 Design of an enhanced flat-plate solar collector. L. S. Fletcher and S. Ahiskali (Rutgers University, New Brunswick, N.J.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 171-177. 8 refs. Research supported by Rutgers University.

The design, fabrication and preliminary testing of an enhanced flat-plate solar collector for water heating is presented. The enhanced collector combines the advantages of both flat-plate collectors and concentrating collectors by incorporating a two-stage heating process. The primary stage heats the water by means of the standard absorption process and the secondary stage utilizes the heated water from the primary stage and increases the temperature by means of longitudinally placed parabolic reflectors. Preliminary experimental results demonstrate that higher temperatures may be achieved per unit area with the enhanced collector than with a more conventional flat-plate collector. (Author)

A76-31387 A parabolic collector using composite construction. P. Rojeski, Jr. and G. W. Sams (Tulsa, University, Tulsa, Okla.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 179-188.

Initial studies related to the development of practical concentrating collectors for air conditioning applications in the southern regions of the U.S. showed the superiority of a parabolic cylinder over a Fresnel unit. As a result of these studies a concentrating collector prototype consisting of a reflective parabolic cylinder was constructed. The prototype is mounted at an inclined angle on rotational supports which allow the reflector to track the sun from east to west. The reflector consists of a silvered-glass reflecting surface, paper honeycomb backing, and an exterior aluminum skin. An evaluation indicates that light-weight, durable parabolic cylinder collectors can be built at prices which are competitive with the more elaborate flat-plate designs. G.R.

A76-31388 Thin-film-coated cover plates for solar collectors. R. P. Taylor and R. Viskanta (Purdue University, West Lafayette, Ind.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 189-207. 19 refs.

The investigation is concerned with the improvements in flat-plate solar collector performance which can be obtained by using as cover plate a glass sheet that is coated on the inner side with a semiconducting metallic oxide film. In this case the cover plate which transmits the solar spectrum is at the same time a good reflector of the long-wavelength thermal radiation emitted by the

absorber. The reflection of this thermal radiation provides an approach for reducing the thermal radiation losses of the collector. A description is given of a steady one-dimensional collector model which emphasizes spectral directional radiation heat transfer. Some optimum thin-film configurations are determined with the aid of nonlinear programming theory. G.R.

A76-31389 Development of a prototype faceted fixed-mirror solar concentrator. J. R. Williams (Georgia Institute of Technology, Atlanta, Ga.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 209-227. 8 refs. NSF Grant No. GI-43936.

A faceted fixed mirror concentrator (FFMC) that focuses sunlight sharply regardless of the incident light direction has been proposed by Russel (1972) as a possible cost-effective means of collecting heat at around 600 C for central station electric power generation. Theoretical predictions regarding the FFMC could be verified with the aid of a small 61 sq ft concentrator. A description is given of the design of a 540 sq ft prototype FFMC, taking into account aspects of device geometry and performance. G.R.

A76-31391 A simulation study of a solar flat-plate collector. W. B. Reuland, W. E. Russell, and J. B. Scott (Clemson University, Clemson, S.C.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 235-247. 5 refs.

The reported computer simulation study takes into account the meteorological conditions which affect the operation of the flat-plate solar collector. A description of the code used in the computer simulation program is presented, taking into account the various subroutines. Attention is given to the approach employed for modeling the amount of insolation available for a given 15 minute interval. It is concluded that a modeling approach to random weather variations is a valid method for obtaining design and feasibility information for solar systems. G.R.

A76-31392 Application of thermic diode solar panels. S. Buckley (MIT, Cambridge, Mass.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 249-265. 11 refs. Research supported by the Cabot Solar Energy Fund and NSF.

Thermic diode solar panels are a new method of collecting, controlling and storing solar energy. These panels, incorporated into the walls and roof of a building, absorb solar energy on a winter day, but become insulators on a winter night. During a summer day they become insulators but dissipate heat during a summer night; thus both heating and air conditioning costs are saved. Since the panels cost about as much as the walls and roofs they replace, there is no high first cost associated with conventional solar energy systems for buildings. Thermic diode panels have no moving parts and require no external power other than that provided by the sun. Both vertical wall and angled roof orientation are possible. (Author)

A76-31393 Design guidelines for solar heating systems. T. E. Shoup and L. S. Fletcher (Rutgers University, New Brunswick, N.J.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 269-282. 19 refs.

This paper presents a discussion of recent literature related to design procedures for residential applications of solar heating. The objectives of this review are three-fold: to establish a classification scheme for categorizing various design procedures presented in the literature; to provide a summary of some of the more important general design guidelines gleaned from the literature; and to recommend where further efforts in the design literature need to be made. (Author)

A76-31394 Principles of solar concentrator design. D. G. Burkhard (Georgia, University, Athens, Ga.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 283-291.

A differential equation is obtained for the shape of a reflecting surface which will distribute axially symmetric light intensity into a specified irradiance over a receiver which is symmetric about the direction of the incident light. Results are applied to the design of rotationally symmetric solar reflectors and also to a two-dimensional geometry, that is, one in which the reflector is a cylinder with its axis perpendicular to the incident beam. (Author)

A76-31395 Solar space heating with aquifer heat storage - A design study. R. C. Brothers (DuPont de Nemours Co., Inc., Victoria, Tex.) and C. P. Wilhite (Kansas, University, Lawrence, Kan.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 293-304. 9 refs. Research supported by the University of Kansas.

In solar energy system studies at Kansas University the technical feasibility was evaluated to store large quantities of hot water in an aquifer which underlies the university area. When a mathematical simulation of fluid flow and heat transfer showed that the concept of aquifer heat storage was practical, an analysis was conducted of the economics of solar space heating with aquifer storage for the university. Systems utilizing either flat-plate or parabolic trough collectors were considered. It was found that for small-scale installations, or as an alternative to currently operating heating facilities, the examined solar energy system cannot be economically justified. However, such a system is competitive with a coal-fired facility if large-scale installations are considered. G.R.

A76-31396 Comparative evaluation of solar cooling concepts. H. M. Curran and T. Alereza (Hittman Associates, Inc., Columbia, Md.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 305-325. NSF Grant No. C-858.

A comparison is made of three building cooling concepts which are primarily solar-powered. These are: (1) the solar Rankine concept in which a Rankine cycle driven by solar energy is used to drive a vapor compression refrigeration machine, (2) the solar-assisted Rankine concept in which a Rankine cycle driven by both solar energy and fuel combustion is used to drive a vapor compression refrigeration machine, and (3) the solar absorption concept in which solar energy is used to drive an absorption refrigeration machine. Both flat plate and concentrating solar collectors are considered. The comparison is made on the basis of the following four criteria: coefficient of performance, collector area requirement, payback period, and requirements for primary (non-solar) energy. The general conclusion is that the solar-assisted Rankine concept is superior to the other two with respect to the first three criteria, and that the solar Rankine concept is superior to the other two with respect to the fourth criterion. (Author)

A76-31397 * Performance simulation for the design of solar heating and cooling systems. P. O. McCormick (Lockheed Missiles and Space Co., Inc., Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 327-332. Research supported by the Lockheed Independent Development Funds, NASA, and NSF.

Suitable approaches for evaluating the performance and the cost of a solar heating and cooling system are considered, taking into account the value of a computer simulation concerning the entire system in connection with the large number of parameters involved. Operational relations concerning the collector efficiency in the case of a new improved collector and a reference collector are presented in a graph. Total costs for solar and conventional heating, ventilation,

and air conditioning systems as a function of time are shown in another graph. G.R.

A76-31398 * Experimental evaluation of a solar concentrator. L. J. Hastings (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 333-358. 8 refs.

A program concerned with the development of a large scale solar concentrator/collector subsystem is considered. Distributed collector approaches are related to the use of a parabolic mirror, a Fresnel reflector, and a Fresnel lens. A system description is given, taking into account questions of turbine interface selection and aspects of collector field layout. Performance sensitivity studies on particular components and parameters are discussed along with performance data which have been obtained for parabolic reflector, Fresnel lens, and Fresnel reflector concentrators. Attention is given to details regarding the design, the operation, and the status of development of the collection subsystem which is being developed. G.R.

A76-31399 Solar energy/heat pump alternatives for energy conservation in residential applications. F. O. Calvert and D. G. Harden (Oklahoma, University, Norman, Okla.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 359-371.

Approaches for saving energy by following suitable directions in the design of buildings and their heating and cooling systems are considered, taking into account the use of heat pumps and solar energy. A description of a solar-assisted heat pump system is given. A promising concept is represented by a system in which all heating on days when the sun shines is by means of solar energy and conventional hot water radiation. Heating on cloudy days is by means of air-to-air heat pumps. G.R.

A76-31400 Liquid subsystems for collection, storage, and distribution of solar heat. C. C. Smith, G. O. G. Lof, and D. S. Ward (Colorado State University, Fort Collins, Colo.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 373-388.

Subsystem design criteria, heat extraction from solar collectors, heat storage and load distribution, design of the collector fluid circuit, heat exchangers, loop hardware (piping, pumps, vented storage tanks, valves), system electric power requirements, and system/subsystem costs are discussed. Pure ethylene glycol, aqueous ethylene glycol solution (60% ethylene glycol), water, and aqueous methanol (40%) solution were tested, and the aqueous ethylene glycol solution is recommended as solar collector fluid, water as heat storage and load distribution medium. Space heating of buildings is the central task discussed, and attention is given to compatibility of the solar heating system and building requirements (structural building codes, boiling and freezing hazards, corrosion control). Power failure and pump stoppage problems are considered. Liabilities in the use of a thermosiphon are dealt with. R.D.V.

A76-31401 Low-temperature Rankine air conditioning. J. A. Bond and C. S. Robertson, Jr. (General Electric Co., Valley Forge, Pa.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 389-404. 8 refs.

The reported investigation is concerned with a building cooling system in which a low-temperature Rankine engine drives a conventional vapor compression refrigeration system. The heat input to the Rankine engine is provided by solar energy via a collector loop and energy transport loops. An auxiliary electric motor is provided to power the refrigerant compressor when the available solar energy is insufficient. The system potential and current status are examined, taking into account a demonstration which shows the feasibility of

the considered system. Design and operational details concerning a solar heated system are discussed. G.R.

A76-31402 * An analysis for designing solar concentrator-collector configurations. J. H. McDermit (Lockheed Missiles and Space Co., Inc., Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 405-429. 18 refs. Contract No. NAS8-30268.

An analysis for predicting the heat flux distribution on collectors in the focal region of solar concentrators has been formulated. The analysis is rather general and can consider limb darkening effects, collector placement errors, concentrator optical errors, and concentrator pointing errors. By coupling finite differencing techniques and heating requirements to this analysis, it can also be used to design concentrators that give prescribed heating on the collector surface. Illustrative results are presented. It is concluded that the concentrator and collector should be designed as a unit and that concentrator configurations that are more desirable than the paraboloid and cylindrical parabola can be designed. (Author)

A76-31403 Solar heating and cooling of mobile homes. S. L. Macklis (General Electric Co., Valley Forge, Pa.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 437-449.

The design of a first generation integrated solar mobile home is discussed. The solar collector assembly consists of 19.3 ft. by 8 ft. panels arranged in three banks at a tilt angle of 40 deg. Solar thermal energy is used to heat the water/ethylene glycol working fluid. The cooling system is based on a three-ton lithium bromide/water absorption system modified for operation with hot water. A flash-type domestic hot water heater with a solar pre-heat coil is located in the thermal energy storage tank. The control system provides automatic mode switching in response to thermostat requirements and system temperature. Predicted system performance data are given, and the results of a preliminary economic analysis are discussed. C.K.D.

A76-31404 Design, performance, and architectural integration on solar heating system using reflective pyramid optical condenser. E. M. Wormser (Wormser Scientific Corp., Stamford, Conn.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 451-460.

This paper describes the design and performance properties of a solar heating system employing a reflective pyramid optical condensing system. The optical focusing system concentrates solar energy by a factor of 3x to 5x and reduces the requirement for flat-plate collectors by that factor. By concentrating the solar energy, the density of radiation at the flat-plate collector and, as a result, the rise in temperature are both increased, and the losses are minimized. Results of comparative tests of the focusing system and a flat-plate unit of comparable size are reported. Examples are given of the architectural integration of the system with dwellings of conventional design. The system is easily integrated with only minor changes in architectural design and minimum effect on aesthetic appearance. (Author)

A76-31405 Solar heating a Boston school. J. E. Notestein (General Electric Corp., Valley Forge, Pa.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 461-483.

The design and construction of a large scale solar heating system for a public school are discussed. The system is based on a 4608 sq. ft., three row solar array utilizing a water-glycol fluid loop and 144 flat plate collectors. The system is designed to provide 450-500,000 BTU/hr, with 80 to 100 BTU per sq. ft. of collector. The thermal energy storage tank has a capacity of 2000 gallons. System layouts are presented, and cost breakdowns are given. C.K.D.

A76-31406 Performance analysis of solar service hot water systems in the northwestern United States. C. B. Winn, P. M. Soot, and W. R. Szmyd (Colorado State University, Fort Collins, Colo.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 485-498. 6 refs.

A76-31407 Comparative performance analyses of three solar heated and cooled buildings. C. B. Winn and G. R. Johnson (Colorado State University, Fort Collins, Colo.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 499-510.

Three buildings with solar heating and cooling were simulated using the program SIMSHAC at Colorado State University (CSU). The first building is the CSU solar house 1, which contains 3000 sq ft of floor area and a solar system which consists of 750 sq ft of collectors, an 1100 gallon water storage tank, an 80 gallon pre-heat tank for service hot water, a 3 ton lithium bromide absorption refrigeration unit for air conditioning, with a combination of water and ethylene-glycol as working fluid. The second building is a private house in Colorado with 3500 sq ft of floor area, uses air as the transport medium rather than water, has 1200 sq ft of collectors and a heat storage unit consisting of 6000 pounds of rocks stored beneath the living room. The third building is CSU solar house 2, similar in design to solar house 1, but designed to be an air system. It was found that the two CSU solar systems perform nearly the same even though one is an air system and the other is a water system. Four hour average values are plotted for various solar system parameters including: ambient temperature, solar insolation, storage temperature, collector output temperature and building heat loss. B.J.

A76-31408 Solar heating of a commercial office building. S. F. Gilman (Pennsylvania State University, University Park, Pa.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 511-515.

Data are given on the performance of a heat pump assisted solar heating system used in a commercial office building in Albuquerque, N.M. The original system, constructed in 1956, featured a 750 sq. ft. water-type solar collector, a 6000 gallon underground water storage tank, one water-to-water heat pump, and five water-to-air packaged heat pumps. The system was recently refurbished, with the addition of an ethylene glycol-to-water heat exchanger, pump, and piping system. The refurbished system is capable of operation in direct heating and heat pump heating modes. The average coefficient of performance for a 100 day period from mid-December to mid-March 1974 was about 8.0. The energy required by the system was 12.5% of that which would have been required by an electrical resistance heating system. C.K.D.

A76-31409 Integrated home energy system. C. H. Long (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 521-537.

Possible means of salvaging and using heat energy wasted in a typical household are examined, and an integrated home energy system designed to reduce the energy consumption in a nine room house for a family of four is described. A heat exchanger which uses heat energy normally lost from dishwasher, shower, washer and dryer to preheat hot water from 50 to 85 deg for use in the home is recommended. A five-pass heat exchanger in a solar hot water tank would then heat the water to 140 deg before it entered a standard hot water heater. A combination of solar heating and heat pump heating is suggested to heat and cool the house. Cost break-downs are presented for the system components. C.K.D.

A76-31410 Use of solar energy in a soybean processing operation. A. Reisz. In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 539-549. 6 refs.

A76-31411 A simulation model for solar thermal electric power systems. G. R. Johnson and N. El Gabalawi (Colorado State University, Fort Collins, Colo.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 553-572. 9 refs. NSF Grant No. GI-37815.

The paper discusses SIMSTEPS, a generalized computer simulation model for the dynamic performance analysis of solar thermal electric power systems. The current subsystem models contained in the program are briefly described, including those for the Fresnel reflectors, the absorber, the steam accumulator, and the steam turbine. The simulation of a 12-MW distributed power plant is outlined, and results are presented for simulated operation at three sites in the southwestern United States. These results include a typical day's operation in spring, winter, and summer, the controls necessary for efficient use of the solar thermal storage unit, the monthly power production, and histograms of the daily output for each site. Preliminary estimates are made of the costs per kilowatt-hour of output. F.G.M.

A76-31412 Solar insolation transients - Their impact on the design and testing of solar thermal power plants. C. A. Lindley (Aerospace Corp., Los Angeles, Calif.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 573-590.

The passage of cloud shadows over the collector mirror field of a solar thermal power plant may impose severe thermal transients on certain components of the power plant. The most vulnerable components are expected to be the tubes of the receiver-boiler, the steam turbine, the steam downpipe, and the power plant control system. The preferred solutions will vary with the power plant configuration and will require careful attention in the detailed design to the impact of transients. But these transients will not impose a strong leverage on the choice of power plant configuration. The development testing of a given design must be carefully planned to prove the proper handling of the transient problem. (Author)

A76-31413 Minimum-cost solar collector fields. W. S. Duff (Colorado State University, Fort Collins, Colo.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 591-604. NSF Grant No. GI-37815.

Two slightly different optimization (dynamic programming) models are used to find a minimum cost of thermal power field for the specified solar collector field conditions. The first model synthesizes feeder line subsystems consisting of a collector and its associated heat transport segment into minimum cost feeder lines. The second model, requiring inputs from the first, synthesizes trunk line subsystems consisting of a feeder line junction and its associated heat transport segment into minimum cost fields. In other words, to initiate the optimization procedure, a collector, heat transport fluid, piping arrangement, field outlet temperature and inlet temperature are specified. Feeder lines are synthesized, followed by the synthesis of trunk lines to find a minimum cost of thermal power. The optimization method is illustrated by application to fields producing hot water and steam. B.J.

A76-31414 Solar thermal electric power systems. W. S. Duff and S. Karaki (Colorado State University, Fort Collins, Colo.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 605-614. 5 refs. NSF Grant No. GI-37815.

A systems optimization approach was formulated to find minimum-cost solar thermal energy power systems. Uniform parametric cost and performance models were derived for a wide variety of systems, which were assumed to be connected into a power grid. Heat transfer and transport fluids were limited to steam and water; the only working fluid considered was saturated steam. Steam accumulators and pressurized hot water storage were included, together with a wide selection of concentrator types and absorber-heat exchangers. Results for all components studied are presented. The minimum cost choice between tower-heliostat and distributed systems is dependent on the size of the system. A low cost STEP system may be in the 5 to 500 MW range and of either system type. Higher temperatures should be considered. C.K.D.

A76-31415 Air Force sponsored photovoltaic research. J. M. Green (USAF, Wright-Patterson AFB, Ohio). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 615-625. 11 refs.

Although Air Force solar-energy research is primarily directed toward power systems for military satellites, some efforts offer potential benefits to the terrestrial application of photovoltaic power-generating systems. Three such programs are described. The process of electrostatic bonding is being developed to apply glass covers to solar cells by an electrochemical reaction which would eliminate the task of adhesively bonding covers to each cell by hand. This process can reduce the cost of covering from \$2.50 to \$0.25 per cover. A solar cell which has 1000 vertical junctions per centimeter instead of a single junction parallel to the surface is under development. This vertical multijunction solar cell has enhanced long-wavelength response which makes it attractive for earth-based systems and vastly improved radiation resistance necessary for space systems. Lightweight solar array research was pioneered by the Flexible Rolled-Up Solar Array Program. This array used a flexible substrate which can be rolled up compactly on to a cylindrical drum to save both weight and volume in the satellite system. (Author)

A76-31416 * Hydrogen as an energy vector. W. D. Powers (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 627-632.

The feasibility of utilizing hydrogen as an energy vector is considered, with special attention given to means of hydrogen production. The state-of-the-art in thermochemical processes is reviewed, and criteria for the technical and economic feasibility of large-scale thermochemical water splitting processes are presented. The production of hydrogen from coal and from photolysis of water is discussed. C.K.D.

A76-31417 A preliminary investigation of the Darrieus wind turbine. J. H. Strickland, S. R. Ford, and C. B. Reddy (Texas Tech University, Lubbock, Tex.). In: Application of solar energy; Proceedings of the First Southeastern Conference, Huntsville, Ala., March 24-26, 1975. Huntsville, Ala., UAH Press, 1975, p. 633-643. 7 refs. Research supported by the Texas Tech University.

This paper describes work which is presently in progress at Texas Tech University concerning the characteristics of the vertical axis Darrieus wind turbine. A computer model which is capable of predicting the steady-state performance of the Darrieus rotor has been developed and is presently being extended to include transient behavior as well as behavior in spatially nonuniform winds. A 14 ft diameter two-bladed Darrieus rotor has been constructed and installed on flat, open terrain adjacent to the Texas Tech campus. This rotor was instrumented such that the energy extraction rate as a function of wind speed and rotor speed could be measured and controlled. Various aspects of the design and operation of this system are discussed along with analytical and experimental performance results. (Author)

A76-31474 **ERDA and the Advanced Power Conversion Program.** W. M. Crim, Jr. (U.S. Department of the Interior, Office of Coal Research, Washington, D.C.). *Mechanical Engineering*, vol. 98, May 1976, p. 24, 25.

The Advanced Power Conversion Program sponsored by the U.S. Energy Research and Development Administration (ERDA) is reviewed. This program centers on the development of fossil energy, including coal, oil shale, petroleum, and natural gas. Open-cycle and closed-cycle MHD systems, electric-gas dynamics (EGD) systems, conversion and utilization of coal and coal-derived fuels in an environmentally acceptable technology, the development of advanced power cycles, improved performance in turbine/steam systems, and advanced support technologies (seals, bearings, rotors, materials, instrumentation) are covered in the program. Other ERDA research and development programs center on: energy conservation, environment and safety, nuclear energy, national security (and nuclear materials), and advanced energy systems (solar, geothermal, fusion, wind power). R.D.V.

A76-31476 **Technology for the new horizon; Proceedings of the Thirteenth Space Congress, Cocoa Beach, Fla., April 7-9, 1976.** Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1976. 313 p. \$21.25.

The congress was devoted to the following topics: Spacelab program and payloads, marine sciences and remote sensing, Space Shuttle technical problems, international aeronautics, solar energy conversion, the role of man in space flight operations and communication satellite programs. Papers are presented on the application of radar scattering to ocean wave research and the study of ocean internal waves using satellite imagery and ship data. Technical challenges of integrating the Space Shuttle are studied together with lightning problems likely to be encountered by the Shuttle and the problems of autoignition, ice and frost accumulation, dewatering, noise suppression and payload processing in relation to Shuttle development. Hydrogen production using solar energy, the photoelectrolysis of water by solar energy and the use of satellites to determine optimum locations for solar power stations are all discussed. Also considered are the development and utilization of the Telesat, the Marisat and the Symphonie systems.

B.J.

A76-31494 **New technologies in solar energy conversion - An overview.** G. W. Lowery and C. D. Beach (Florida Solar Energy Center, Cape Canaveral, Fla.). In: *Technology for the new horizon; Proceedings of the Thirteenth Space Congress, Cocoa Beach, Fla., April 7-9, 1976.* Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1976, p. 6-1 to 6-6. 23 refs.

Useful sources of solar energy include energy stored in oceans, winds, elevated waters, and biological materials. Requirements for efficient capture and use of solar energy are discussed relative to conversion, storage, and concentration of the captured energy. Particular attention is given to technological status as applied to solar thermal conversion, photovoltaic conversion, ocean thermal energy conversion, wind energy conversion, and bioconversion. Problems relevant to each of these technologies are examined, with special reference to feasibility, economics, and practical applications. S.D.

A76-31495 **Hydrogen production by solar beam.** T. Ohta (Yokohama National University, Yokohama, Japan) and T. N. Veziroglu (Miami University, Coral Gables, Fla.). In: *Technology for the new horizon; Proceedings of the Thirteenth Space Congress, Cocoa Beach, Fla., April 7-9, 1976.* Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1976, p. 6-7 to 6-12. 14 refs.

Different methods of water decomposition by means of solar energy are reviewed and evaluated. Emphasis is on such methods as direct thermal, thermochemical, hydro-electrolytic, photolytic, and biochemical. These methods correspond to situations involving the change of Gibbs free energy, the change of heat energy, or both. The direct thermal method yields the highest efficiency, but the difficulty lies in the heat-resistant materials. The development of

corrosion-resistant materials is a decisive factor in promoting the use of the thermochemical method on a larger scale. A hybrid electrolytic system combined with thermochemical and/or photochemical reactions is promising for hydrogen production. The efficiency of biological photocatalysts in producing hydrogen is too low to be practical in the present stage. S.D.

A76-31496 **Solar Total Energy at Sandia Labs.** J. A. Leonard (Sandia Laboratories, Albuquerque, N. Mex.). In: *Technology for the new horizon; Proceedings of the Thirteenth Space Congress, Cocoa Beach, Fla., April 7-9, 1976.* Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1976, p. 6-13 to 6-16.

The Sandia Laboratories' Solar Total Energy Program is described. This program consists of designing, building, installing, and operating a field of concentrating parabolic trough solar collectors which provide energy at 310 C, a 32-kW organic Rankine cycle power plant, and the heating and cooling equipment to utilize the cascaded, low-temperature energy from the turbine/generator. Included in the presentation are descriptions of the total energy system, its components, its performance characteristics, a status report, and a discussion of future plans. (Author)

A76-31497 **Photoelectrolysis of water by solar energy.** D. I. Tchernev (MIT, Lexington, Mass.). In: *Technology for the new horizon; Proceedings of the Thirteenth Space Congress, Cocoa Beach, Fla., April 7-9, 1976.* Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1976, p. 6-17 to 6-23. DARPA-USAF-sponsored research.

The direct conversion of solar energy to hydrogen fuel is possible by photoelectrolysis in a photoelectrolytic cell consisting of a semiconducting working electrode, an electrolyte, and a Pt counterelectrode. The electrochemistry of photoelectrolysis is studied by experiments on cells with n-type polycrystalline and single-crystal TiO₂ anodes as well as with SrTiO₂ anodes. Conditions necessary for efficient photoelectrolysis are determined. Whatever method is employed to obtain the required matching of energy levels between the cathode and the electrolyte, the efficiency with which solar energy can be utilized to generate H₂ by photoelectrolysis ultimately depends on the semiconductors that are used as electrode materials. The chemical stability of these semiconductors under illumination in an electrolyte is discussed. 100% quantum efficiency is observed without corrosion of the electrodes. Projected costs of large-area thin-film devices based on existing technology indicate that hydrogen fuel can be cost competitive with presently used fuels. S.D.

A76-31498 * **Use of satellites to determine optimum locations for solar power stations.** H. W. Hiser and H. V. Senn (Miami University, Coral Gables, Fla.). In: *Technology for the new horizon; Proceedings of the Thirteenth Space Congress, Cocoa Beach, Fla., April 7-9, 1976.* Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1976, p. 6-25 to 6-33. 13 refs. Contract No. NAS5-22417.

Ground measurements of solar radiation are too sparse to determine important mesoscale differences that can be of major significance in solar power station locations. Cloud images in the visual spectrum from the SMS/GOES geostationary satellites are used to determine the hourly distribution of sunshine on a mesoscale in the continental United States excluding Alaska. Cloud coverage and density as a function of time of day and season are considered through the use of digital data processing techniques. Low density cirrus clouds are less detrimental to solar energy collection than other types; and clouds in the morning and evening are less detrimental than those during midday hours of maximum insolation. The seasonal geographic distributions of sunshine are converted to Langley's of solar radiation received at the earth's surface through the use of transform equations developed from long-term measurements of these two parameters at 18 widely distributed stations. The high correlation between measurements of sunshine and radiation makes this possible. The output product will be maps showing the

geographic distribution of total solar radiation on the mesoscale which is received at the earth's surface during each season. (Author)

A76-31832 Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Symposium sponsored by the Electrochemical Society. Edited by J. B. Berkowitz (Arthur D. Little, Inc., Cambridge, Mass.) and H. P. Silverman (TRW Systems, Redondo Beach, Calif.). Princeton, N.J., Electrochemical Society, Inc., 1976. 267 p. \$8.00.

The development of new types of energy storage technology is examined with attention paid to electric and electrochemical energy storage, hydrogen production and storage, underground compressed air and underground pumped hydro storage, magnetic storage and thermal storage. Particular topics discussed include target capital costs for the utilization of fuel cells and electric storage devices within the national energy system and the use of superconductor energy storage systems. Much emphasis is placed on the use of storage batteries including lead-acid, zinc-chlorine, sodium-sulfur, sodium chloride and water batteries. Thermal energy storage using fluorides of alkali and alkaline earth metals and thermal energy storage for utility applications are discussed.

B.J.

A76-31833 Energy storage - Applications, benefits and candidate technologies. F. R. Kalhammer (Electric Power Research Institute, Palo Alto, Calif.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings.

Princeton, N.J., Electrochemical Society, Inc., 1976, p. 1-20. 12 refs.

Consideration of current uses of energy storage and its potential for favorable impacts on conservation, energy economics and environmental quality point to electric utility systems, transportation, the residential/commercial sector, and utilization of solar energy as major new opportunities for energy storage. The use of energy storage in these areas is discussed and some of the possible benefits are identified. Economic prospects are examined for utility energy storage, an application amenable to simplified economic analysis. In addressing existing and future opportunities, technologies for storage of mechanical, chemical, thermal and electromagnetic energy are being developed. The most promising technologies are reviewed briefly and their prospects for practical applications are examined. (Author)

A76-31834 The target capital costs for the implementation of fuel cells and electric storage devices within the national energy system. C. Braun, E. A. Cherniavsky, and F. J. Salzano (Brookhaven National Laboratory, Upton, N.Y.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 21-53. 15 refs.

A76-31835 Energy storage technology. A. R. Landgrebe and K. W. Klunder (ERDA, Washington, D.C.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 54-63.

A review is given of current energy storage technology and of the prospects of new technology with particular emphasis on the role of the Energy Research and Development Administration (ERDA). Present technologies (gas turbine and pumped storage) are briefly discussed and the program basis for the development of electric energy storage for automobile and other applications is considered. R and D goals are examined emphasizing programs seeking to develop nonpetroleum-dependent vehicular storage concepts (chemical, thermal, mechanical and hybrid) which will permit initial market penetration on a competitive basis. Allowed cost criteria are presented as are criteria and ratings for storage technologies and alternatives (electric storage batteries, hydrogen production and

storage, flywheels, underground compressed air storage, underground pumped hydro storage, magnetic energy storage and thermal energy storage). B.J.

A76-31836 The use of superconductors as energy storage elements. Z. J. J. Stekly (Magnetic Corp. of America, Waltham, Mass.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 64-81. 28 refs.

The high current density and high magnetic fields of superconducting coils make them ideal for consideration as electrical energy storage elements. The paper reviews the current state of the art of superconducting magnets and their characteristics. Following this is a discussion of the current and proposed applications of superconducting magnets for energy storage-pulsed power supplies, pulsed homopolar machines, short term load leveling, and utility peak load shaving. (Author)

A76-31837 Hydrogen production, storage, and conversion for electric utility and transportation applications. S. Srinivasan and R. H. Wiswall (Brookhaven National Laboratory, Upton, N.Y.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 82-108. 18 refs. ERDA-sponsored research.

Hydrogen is a promising fuel of the future, particularly for electric utility and transportation applications. An essential requirement in both these applications is the necessity for optimizing the intermediate steps of hydrogen production, its storage and conversion from the point of view of capital cost, energy utilization, and energy conversion efficiency. At the present time, the energy efficiency for hydrogen production by water electrolysis is about 75%. With improved catalysts, higher operating temperatures and better separator materials in advanced systems it should be possible to carry out water electrolysis at close to 100% efficiencies. The storage of hydrogen as a metal hydride shows significant advantages over the cryogenic or compressed gas procedures. With fuel cells or combined cycle gas turbines, it should be possible to attain energy conversion efficiencies of about 60%. The present status and potential for improvements in acid, alkaline, molten carbonate, and solid oxide fuel cell systems are briefly summarized. (Author)

A76-31839 Electrolyte stoichiometric considerations for zinc deposition in the zinc-chlorine battery. A. F. Sammells (Gould, Inc., St. Paul, Minn.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 121-129. 11 refs.

The zinc-chlorine battery is presently being developed for both load leveling and vehicular type applications. The electrode reactions occurring during both charge and discharge take place under flowing electrolyte conditions and result in significant concentration changes in the aqueous zinc chloride electrolyte. The zinc deposited upon the charge cycle is influenced by several parameters, the more important of which appear to be cationic impurities in the electrolyte, pH change occurring during the charge cycle, and the electrolyte hydrodynamic flow conditions. The relative influence of these parameters on the quality of the electrodeposited zinc is discussed and their influence on the performance of the system evaluated. (Author)

A76-31840 The sodium-sulfur battery - A progress report. S. A. Weiner (Ford Motor Co., Dearborn, Mich.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 141-154. NSF-supported research.

This paper presents some of the work on sodium-sulfur cells with emphasis on various aspects of cell design and testing. In addition, a brief discussion of the influence of metal additives on sulfur electrode performance is included. The base line studies for the cell testing program were run on cells that were constructed of

carbon and glass and contained no metal other than sodium. Separate cells, designed to maximize energy and power density, respectively, were studied. (Author)

A76-31842 The performance of prototype sodium sulfur cells. M. W. Breiter, J. B. Bush, Jr., S. P. Mitoff, O. Muller, and W. L. Roth (General Electric Co., Schenectady, N.Y.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 165-178. Research sponsored by the Electric Power Research Institute.

In this paper, we describe the experimental evaluation of a prototype 17 ah sodium-sulfur cell. The procedures employed for evaluating electric performance and for the analysis of causes of failure will be described. The capacity decline and cell resistance increase that were previously reported are related to the materials of construction of the cathode compartment. The origin of and phenomena associated with abrupt failure, principally due to development of internal short circuits will be discussed. (Author)

A76-31843 A water-battery concept for electric utility energy storage. J. E. Clifford and E. W. Brooman (Battelle Columbus Laboratories, Columbus, Ohio). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 179-197.

The water battery (reversible water electrolyzer or regenerative hydrogen-oxygen fuel cell), as envisioned by BCL, is a single energy-storage device with long operational life and high storage efficiency suitable for use on an electric utility system at dispersed locations (e.g., substations). Available off-peak electric energy could be used to electrolyze water, thereby generating hydrogen and oxygen which can be stored externally to the device. These gases in turn could be recycled, as necessary, through the same device, operating in reverse, to generate direct-current electricity to meet utility system peak load demands. The technical feasibility and economic feasibility of such a device are considered and found to be attractive for load-leveling applications. Capital cost estimates are presented for a daily and a weekly duty cycle, based upon estimated near-term, and projected long-term performance goals. (Author)

A76-31844 The sodium chloride battery. J. Werth, I. Klein, and R. Wylie (ESB Technology Center, Yardley, Pa.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 198-205. 15 refs.

The sodium chloride cell offers considerable promise for lightweight, long life, and low temperature rechargeable molten salt batteries. The advantages of this cell are its high energy density, its negligible coulombic and stand losses, its high cell voltage, its high utilization of active materials, and the low cost of its active materials, seals, current collectors, and containers. The cell uses a molten sodium negative, a ceramic separator-electrolyte, and a molten chloride positive. The energy density for a large battery is about 50 Whr/lb; the turnaround efficiency ranges from 80 to 90% at the 10 hour rate; and the 200 C operating temperature is the lowest for any molten salt battery reported and tested to date. Small (2 Whr) cells have been continuously cycled at 100% depth of discharge up to 10,000 hr and beyond without significant degradation. (Author)

A76-31846 Thermal energy storage for utility applications. D. C. Golibersuch, F. P. Bundy, P. G. Kosky, and H. B. Vakil (General Electric Co., Schenectady, N.Y.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 221-241. 7 refs.

Opportunities for large-scale thermal energy storage for utility applications are discussed and evaluated. Three representative thermal storage systems are described, namely, hot water 'steam' storage, latent heat-fused salt storage employing a liquid lead heat transfer loop, and reversible chemical energy storage. For each system the operating parameters, efficiencies, costs, environmental and safety

constraints, and R&D problems are discussed. A comparative economic evaluation of the three systems is presented. We conclude that thermal storage is strongly competitive with pumped underground hydro storage and gas turbine peak power generation. (Author)

A76-31847 Materials stability and compatibility in energy storage systems. H. S. Spacil (GE Research and Development Center, Schenectady, N.Y.). In: Symposium on Energy Storage, Dallas, Tex., October 5-10, 1975, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1976, p. 242-252. 5 refs.

Thermodynamic and kinetic analyses of energy storage systems can identify materials instability and degradation. The analyses are performed with the aid of stability diagrams or portions of these using selected variables. The two types of analysis are applied to two examples of energy storage systems: (1) compressed air storage where off-peak energy is used to compress air that is employed during peak demand periods as the combustion air for a gas turbine operating on conventional gaseous or liquid fuel; and (2) a system combining a coal gasifier with a facility for producing H₂ stored during off-peak time and then used as a fuel for steam generator, gas turbine or fuel cell during peak demand periods. B.J.

A76-31848 # Report of the MIT Solar Energy Working Group. Research supported by the MIT Cabot Solar Energy Fund. Cambridge, Mass., MIT Energy Laboratory, 1976. 86 p. 53 refs. \$4.00.

Future directions of research in the field of solar energy at MIT are recommended. The order of implementation of solar energy schemes is predicted to be: passive architectural use of the sun to complement an energy-conserving indoor environment; the burning of wood and waste biomass; hot water supply for a significant fraction of the population; space heating on a large scale; industrial process heat and intermediate temperature heat for air conditioning. The problems of energy storage, sunlight concentration, and policy and legal issues are considered. The state of the art in specific solar technologies, including solar photovoltaic conversion, photolytic and electrolytic production of fuels, fuel production from biomass, and solar thermal electric generation, is summarized. It is recommended that research efforts be directed towards energy production at costs which are competitive with energy produced from fossil fuels at current prices. C.K.D.

A76-31872 Solar energy and building. S. V. Szokolay. London, Architectural Press, Ltd.; New York, Halsted Press, 1975. 156 p. 61 refs. \$18.50.

This volume gives a systematic survey of research into the uses of solar energy for heating and providing other energy requirements of residential and nonresidential buildings. General data on global energy consumption and solar radiation are presented, and various methods available for the conversion of radiant energy into a useable form are examined. These include chemical, electrical, and thermal conversion, flat-plate collectors, heat pumps, concentrators, plane mirrors, parabolic troughs, and paraboloid reflectors. The uses of solar energy discussed encompass domestic water heating, space heating, cooling, air conditioning, water distillation, crop drying, cooking, electricity production, and special functions of solar furnaces. The case for solar houses is argued, and detailed descriptions are presented for 38 houses, laboratories, schools, and offices which employ solar-energy systems. The planning of 'solar communities' is evaluated along with the economics and prospects of solar energy. Commercially available solar units are identified, a set of design guidelines is given, and a system-simulation program is outlined. F.G.M.

A76-31964 * New potentials for conventional aircraft when powered by hydrogen-enriched gasoline. W. A. Menard, P. I. Moynihan, and J. H. Rupe (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 6-9, 1976, Paper 760-469. 15 p. 11 refs. Contract No. NAS7-100.

Hydrogen enrichment for aircraft piston engines is under study

in a new NASA program. The objective of the program is to determine the feasibility of inflight injection of hydrogen in general aviation aircraft engines to reduce fuel consumption and to lower emission levels. A catalytic hydrogen generator will be incorporated as part of the air induction system of a Lycoming turbocharged engine and will generate hydrogen by breaking down small amounts of the aviation gasoline used in the normal propulsion system. This hydrogen will then be mixed with gasoline and compressed air from the turbocharger before entering the engine combustion chamber. The special properties of the hydrogen-enriched gasoline allow the engine to operate at ultralean fuel/air ratios, resulting in higher efficiencies and hence less fuel consumption. This paper summarizes the results of a systems analysis study. Calculations assuming a Beech Duke aircraft indicate that fuel savings on the order of 20% are possible. An estimate of the potential for the utilization of hydrogen enrichment to control exhaust emissions indicates that it may be possible to meet the 1979 Federal emission standards. (Author)

A76-32199 **Energy management - An operational outline.** T. G. Foxworth (Pan American World Airways, Inc., New York, N.Y.). *Shell Aviation News*, no. 434, 1976, p. 26, 27.

An application of the Sperry Digital Avionics System in the NASA flight research Convair 990 is described. The advanced autopilot/flight director system is based on a Sperry 1819A digital computer. The computer is referenced to a landing point and recomputes the trajectory three times per second, taking into account potential energy (height), kinetic energy (speed), aircraft configuration, wind, and other factors. A throttles-closed-to- touchdown landing technique has been demonstrated which results in a 60% fuel saving and a 40% time saving over a conventional approach. A similar system will be used to guide the Space Shuttle in its no-fuel final approach. C.K.D.

A76-32353 **The effects of the noncondensable gas in the heat pipes.** T. Matsushita (National Space Development Agency of Japan, Tokyo, Japan). In: *International Symposium on Space Technology and Science*, 11th, Tokyo, Japan, June 30-July 4, 1975, Proceedings. Tokyo, AGNE Publishing, Inc., 1975, p. 385-392. 8 refs.

In the heat pipe, a heat transfer device with a highly effective thermal conductivity, the continuous evaporation and condensation of its working fluids are taking place. The performance of heat pipes depends considerably on the concentration of the noncondensable gas in the vapor. In this report, the solution of the problem of evaporation and condensation in the presence of noncondensable gas in the vapor is presented from the kinetic point of view. The linearized GK model equations are used for analyzing the problem. For solving these equations, the finite element method is applied. As a result it is demonstrated that the small bulk concentration of the noncondensable gas can have decisive effect on the mass transfer rate. For instance, a bulk mass fraction equal to 5% of noncondensable gas reduces the condensing flux to 20% of the condensation rate for the pure vapor. (Author)

A76-32354 **Development of gas loaded heat pipe.** H. Kimura (Mitsubishi Electric Corp., Kamakura, Kanagawa, Japan). In: *International Symposium on Space Technology and Science*, 11th, Tokyo, Japan, June 30-July 4, 1975, Proceedings. Tokyo, AGNE Publishing, Inc., 1975, p. 393-402.

The direct computational scheme proposed for predicting the performance of a gas-loaded heat pipe is an iterative method in which the heat-pipe characteristics control the computations. The equations of conservation of mass, energy, and momentum are the governing equations. A number of computations were carried out to study the influence of such parameters as gas amount and reservoir temperature on the nature of the vapor/gas interface and the evaporator temperature. A method of optimizing gas-loaded heat pipe design is proposed. V.P.

A76-32355 **Some design considerations of heat pipe system for space use.** K. Oshima (Tokyo, University, Tokyo, Japan). In: *International Symposium on Space Technology and Science*, 11th, Tokyo, Japan, June 30-July 4, 1975, Proceedings. Tokyo, AGNE Publishing, Inc., 1975, p. 403-408.

The physical phenomena that take place in heat pipes are discussed. The effects of a noncondensable gas introduced into a heat pipe and of condensable-gas impurities on heat pipe performance are analyzed and are studied experimentally. The flow field in the heat pipe is studied on the basis of fluid dynamic analysis, and physical interpretations for the starting process and transient flow are proposed. Particular attention is given to the nonlinear heat transfer and other nonlinear characteristics of heat pipes and to the use of these characteristics in designing spacecraft thermal control systems. V.P.

A76-32420 **LiF battery as a power source of balloon observation.** S. Ohta and Y. Otsuka (Tokyo, University, Tokyo, Japan). In: *International Symposium on Space Technology and Science*, 11th, Tokyo, Japan, June 30-July 4, 1975, Proceedings. Tokyo, AGNE Publishing, Inc., 1975, p. 873-877.

A battery composed of a lithium cathode and a carbon-fluoride anode has been developed. The energy density is about ten times that of conventional Mn dry cells at 0 deg C, and the discharge curve is more stable at ambient temperatures below 0 deg C. The LiF cells were used to power the command receiver and low-voltage telemetry transmitter in balloon flight tests. The voltages of the LiF batteries tested remained relatively constant throughout the flights, while those supplied by Mn cells decreased with time. The Mn cells used to power balloons weigh about ten times more than an equivalent series of LiF cells. C.K.D.

A76-32649 **Civil transport technology up to 2000 - NASA believes fuel consumption is the major consideration.** J. P. Geddes. *Interavia*, vol. 31, May 1976, p. 419-421.

The recommendations of a NASA task force formed to establish goals in a comprehensive program for developing fuel conservation technology for the civil air transport industry are compared with typical industry views of the developments that are feasible in the near future. A 9-year research program for an advanced turboprop engine cruising at Mach 0.8 at 9,500 m has been suggested, together with improved engine components for existing engines such as the JT8D, JT9D, and CF6, including mechanical mixers to mix the core and duct stream before discharge through a common nozzle, clearance control to improve compressor and turbine efficiency, and improved blade shapes. Four possible aerodynamic approaches to fuel consumption were selected for future study: drag clean-up, improved aerodynamic design, laminar flow control, and the use of small vertical end-plates on wing-tips to augment thrust. Work in these areas would be divided between an Energy Efficient Transport program and a separate Laminar Flow Control program. A greatly accelerated effort in the development of composite structures is urged. The total cost of the proposed programs is \$670 million; a fuel savings of 79% over a fleet incorporating current advanced technology is predicted for a fleet resulting from the suggested program in the year 2005. C.K.D.

A76-32661 **Amorphous silicon solar cell.** D. E. Carlson and C. R. Wronski (RCA Laboratories, Princeton, N.J.). *Applied Physics Letters*, vol. 28, June 1, 1976, p. 671-673. 10 refs.

Thin film solar cells, about 1 micron thick, have been fabricated from amorphous silicon deposited from a glow discharge in silane. The cells were made in a p-i-n structure by using doping gases in the discharge. The best power conversion efficiency to date is 2.4% in AM-1 sunlight. The maximum efficiency of thin-film amorphous silicon solar cells is estimated to be about 14-15%. (Author)

A76-32698 **Something in the wind - ERDA thinks so.** T. W. Black (Hammond Farrell, Inc., New York, N.Y.). *Machine Design*, vol. 48, May 20, 1976, p. 18-20, 23-26.

Objectives of ERDA with respect to the development of wind-turbine generators are examined. Development difficulties are partly related to dynamics problems which can only be adequately studied with the aid of full-scale models. Attention is given to the selection of exceptionally windy sites, designs for obtaining optimum wind conversion efficiencies, approaches for improving the cost-effectiveness of wind power, the use of composite materials for rotor blades, methods which make unattended operation of the wind turbines possible, the design of bigger blades, and questions concerning the commercial availability of components. G.R.

A76-32743 **Optics in laser fusion.** J. B. Trenholme (California, University, Livermore, Calif.). In: *Optical design problems in laser systems*; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. (A76-32726 15-36) Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 158-162. ERDA-sponsored research.

A different approach to controlled thermonuclear fusion has recently become of interest. Laser light is used to compress and heat a small pellet containing deuterium and tritium. Energy is released in short times at high density, in contrast to the magnetic-confinement approach utilizing long times at low density. Initial experiments are now underway to determine if this method is scientifically feasible; a series of ever-larger Nd(3+) glass lasers is being built in support of this effort. The culmination of this program will be the SHIVA laser system, a \$20-million device which will put well over 10 trillion watts uniformly on a 200-micron target sphere. The design of such a laser system is governed by the desire to maximize the power per dollar, while avoiding damage to the laser. In addition, the target requires extremely uniform illumination and must be protected against destruction before the arrival of the main pulse. The target requirements are considered along with laser design problems, point and focus system, and focusing optics of the SHIVA system.

(Author)

A76-32803 **Solar homes and sun heating.** G. E. Daniels. New York, Harper and Row, Publishers, Inc., 1976. 185 p. \$8.95.

The use of solar energy to heat homes is discussed. The principles of solar heating are outlined, and fourteen types of solar-heating systems, including roof-reservoir sun heating, the Trombe-Michel solar wall, the Thomason system, thermosiphon water heaters, glass-vacuum heat collectors, and sun-tracking flat plate collectors, are described. The use of insulation to maximize heat retention and the adaptation of existing structures for solar heating are considered. Seasonal data on solar radiance for the U.S. are given. C.K.D.

A76-32947 **Propulsion of magnetically levitated trains.** S. L. Wipf (California, University, Los Alamos, N. Mex.). *Cryogenics*, vol. 16, May 1976, p. 281-288. 13 refs. ERDA-supported research.

A propulsion system for magnetically levitated trains is proposed. A method of periodically energizing magnetic loops on a train moving over a periodically undulating track allows the net repulsive magnetic force to tilt forward or backward for either propulsion or braking. The principle is explained and a specific example discussed. Approximate calculations show feasibility. Problems requiring technical solutions which cannot be considered present state-of-the-art are ac losses at frequencies up to 20 Hz and mechanical fatigue properties at low temperatures. Suitable primary power could be derived from hydrogen fuelled turbines yet to be developed.

(Author)

A76-33118 # **Propulsive efficiency from an energy utilization standpoint.** J. H. Lewis, III (Hartford Graduate Center, Hartford, Conn.). *Journal of Aircraft*, vol. 13, Apr. 1976, p. 299-302.

The standard but ill-defined concept of propulsive efficiency, classically employed in the analysis of turbojet and turbofan engines, can be approached from the point of view of energy utilization by applying basic thermodynamic principles. First and second law analysis of propulsive powerplants as general thermodynamic systems leads to a universal definition for propulsive efficiency. This definition clearly accounts for the energy unavailability production separated into two distinct parts: (1) the unavailable energy associated with the thermodynamic cycle's rejected heat; and (2) the wasted energy produced by inefficiencies inherent to the conversion of available cycle energy to propulsive power. As a result, conversion or transfer inefficiencies are consistently reflected in the propulsive efficiency, whereas cycle inefficiencies are most properly identified with cycle, or thermal, efficiency for a powerplant. (Author)

A76-33141 **U.S. energy - The plan that can work.** M. Benedict (MIT, Cambridge, Mass.). *Technology Review*, vol. 78, May 1976, p. 52-59.

The rapid depletion of U.S. oil and natural gas reserves demands the development and implementation of alternative energy sources. The potential contributions of coal, thermal energy, nuclear energy (fusion and fission), hydroelectric and geothermal energy, and oil shale to the energy economies of the years 1985 and 2000 are considered. It is concluded that the most significant fuel sources will be coal and uranium, although the development of new technologies using all potential fuel sources and active conservation measures will be essential to meet future energy needs. C.K.D.

A76-33399 * # **A summary of the ECAS performance and cost results for MHD system.** G. R. Seikel, R. J. Sovie, R. K. Burns, G. J. Barna, J. A. Burkhart, J. J. Nainiger, and J. M. Smith (NASA, Lewis Research Center, Cleveland, Ohio). *Symposium on the Engineering Aspects of Magnetohydrodynamics, 15th, Philadelphia, Pa., May 24-26, 1976, Paper. 21* p. 8 refs.

The interagency-funded, NASA-coordinated Energy Conversion Alternatives Study (ECAS) has studied the potential of various advanced power plant concepts using coal and coal-derived fuel. Principle studies were conducted through prime contracts with the General Electric Company and the Westinghouse Electric Corporation. The results indicate that open-cycle coal-fired direct-preheat MHD systems have potentially one of the highest coal-pile-to-bus-bar efficiencies and also one of the lowest costs of electricity (COE) of the systems studied. Closed-cycle MHD systems may have the potential to approach the efficiency and COE of open-cycle MHD. The 1200-1500 F liquid-metal MHD systems studied do not appear to have the potential of exceeding the efficiency or competing with the COE of advanced steam plants. (Author)

A76-33415 **Thin metal films as applied to Schottky solar cells - Optical studies.** W. A. Anderson, A. E. Delahoy, and R. A. Milano (Rutgers University, New Brunswick, N.J.). (*Optical Society of America and Institute of Electrical and Electronics Engineers, Conference on Laser Engineering and Applications, Washington, D.C., May 28-30, 1975.*) *Applied Optics*, vol. 15, June 1976, p. 1621-1625. 12 refs. Research sponsored by the Rutgers Research Council, Exxon Enterprises, and NSF.

Thin metal films (about 100 Å) have been studied for application to Schottky barrier solar cells (SBSC). Metal films having greater than 55% transmission over the solar spectrum and resistance of 20 ohms/sq cm have been applied to Si to form a rectifying contact. A 9.5% sunlight efficient SBSC was produced using 50-Å Cr adjacent to the Si for good adhesion and high open circuit voltage and a 50-Å Cu overlayer to produce low sheet resistance. Film quality has been related to evaporation rate, metal layer selection, and substrate conditions. Solar cell performance is determined by the transmission and resistance of the thin metal films. Spectral response data show the SBSC to exhibit improved short wavelength sensitivity compared to the p-n Si solar cell. (Author)

A76-33447 * # The use of a very high temperature nuclear reactor in the manufacture of synthetic fuels. G. H. Farberman and L. E. Brecher (Westinghouse Astronuclear Laboratory, Pittsburgh, Pa.). *American Power Conference and Illinois Institute of Technology, Annual Meeting, 38th, Chicago, Ill., Apr. 19-21, 1976, Paper. 21 p.* Contract No. NAS3-18934.

The three parts of a program directed toward creating a cost-effective nuclear hydrogen production system are described. The discussion covers the development of a very high temperature nuclear reactor (VHTR) as a nuclear heat and power source capable of producing the high temperature needed for hydrogen production and other processes; the development of a hydrogen generation process based on water decomposition, which can utilize the outputs of the VHTR and be integrated with many different ultimate hydrogen consuming processes; and the evaluation of the process applications of the nuclear hydrogen systems to assess the merits and potential payoffs. It is shown that the use of VHTR for the manufacture of synthetic fuels appears to have a very high probability of making a positive contribution to meeting the nation's energy needs in the future. S.D.

A76-33449 # H₂ liquefaction - Effects of component efficiencies. R. O. Voth and D. E. Daney (National Bureau of Standards, Institute for Basic Standards, Boulder, Colo.). In: *Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. Conference sponsored by IEEE, AIChE, ANS, SAE, ACS, AIAA, ASME, International Solar Energy Society, American Power Conference, and Electrochemical Society, New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1356-1362.*

Efficiencies of current large hydrogen liquefiers are approximately 30% of Carnot. Although the Carnot cycle work is a good basis for comparing the efficiencies of various refrigerators and liquefiers operating at different temperature levels, the Carnot cycle is not amenable to showing the maximum efficiency for a hydrogen liquefier using practical components. In this paper an alternate cycle is defined that permits evaluation of overall cycle efficiency using practical components with variable efficiencies, variable heat exchanger temperature differences, and variable system pressure drop. The resulting cycle efficiencies will serve as a guide to engineers performing thermodynamic cycle studies to improve the efficiencies of hydrogen liquefiers and will help define the maximum attainable efficiency for future liquefiers. (Author)

A76-33450 # Recovery of hydrogen liquefaction energy. W. R. Parrish (National Bureau of Standards, Institute for Basic Standards, Boulder, Colo.). In: *Energy 10; Annual Intersociety Energy Conversion and Engineering Conference, 10th, Newark, Del., August 18-22, 1975, Record. Conference sponsored by IEEE, AIChE, ANS, SAE, ACS, AIAA, ASME, International Solar Energy Society, American Power Conference, and Electrochemical Society, New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1352-1355. 10 refs.*

Liquid storage is an attractive means for storing the large quantities of synthetic hydrogen that will be needed in the future. However, the actual energy required for liquefaction is roughly 30 percent of hydrogen's lower heating value. This paper considers some ways of recovering part of the liquefaction energy. The emphasis is on utility applications. Results show that it is technically feasible to recover 25 to 50 percent of the actual liquefaction energy if a MHD generator is used; recovery factors of approximately 18 percent could be obtained with gas turbines, and lower recovery factors of 8 to 20 percent are possible if fuel cells are used. This energy recovery has the net effect of lowering the required liquefaction energy which makes liquid a more attractive means of storage. (Author)

A76-33465 # Maximum energy efficiency of linear induction motor in accelerating period. T. Hirasu, S. Ishikawa (Osaka Prefecture University, Sakai, Japan), and T. Kitano. *Osaka Prefecture University, Bulletin, Series A - Engineering and Natural Sciences*, vol. 24, no. 1, 1975, p. 75-86. 6 refs.

This paper deals theoretically with the maximum energy efficiency of a linear induction motor in an accelerating period, for a constant and an adjustable frequency operation. Those conditions relating to the secondary resistance are derived. Based on the condition for the valuable secondary resistance, the resistance is adjusted in proportion to the slip. Based on the other condition for the constant secondary resistance, the resistance is set as a function of the final slip in the accelerating period. By adjusting the resistance, the maximum energy efficiency becomes considerable at the small final slip, especially on the linear motor with small magnetizing reactance. On the other hand, the effect of adjustable frequency operation is evident. (Author)

A76-33509 # Small-scale solar energy focusing device Luch-1 for carrying out technological processes in space (Malogabaritnaia gelioustanovka 'Luch-1' dlia osushchestvleniia tekhnologicheskikh protsessov v kosmicheskom prostranstve). I. N. Frantsevich, V. S. Dverniakov, I. E. Kasich-Pilipenko, V. V. Pasichnyi, A. F. Rozhenko, E. A. Shvartsman, N. V. Shiganov, and Iu. I. Korunov. *Kosmicheskie Issledovaniia na Ukraine*, no. 6, 1975, p. 15-18. 5 refs. In Russian.

The design and characteristics of a space-borne radiant energy focusing device are described which was developed to provide solar stray energy for welding, soldering, cutting, and melting operations. The mechanisms, units, and subsystems which enable semiautomatic operation are described. V.P.

A76-33528 # Physical modeling of combined forced and natural convection in wet geothermal formations. V. E. Schrock and A. D. K. Laird (California, University, Berkeley, Calif.). (*American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov. 30-Dec. 5, 1975, Paper 75-WA/HT-70.*) *ASME, Transactions, Series C - Journal of Heat Transfer*, vol. 98, May 1976, p. 213-220. 17 refs. Research supported by the University of California and ERDA.

Wet geothermal formations or reservoirs are of great current interest as a new energy source. Such formation have the potential for large quantities of energy at temperatures of interest for power production and other uses. In these reservoirs the ground water usually contains dissolved solids in such high concentration as to pose a serious disposal problem. For this reason and also to maintain the water table, in most cases, the water will be reinjected into the reservoir after the useful energy has been extracted. Efficient utilization of the potential of a given reservoir requires optimum location of costly producing and reinjection wells. Selection of well location must be based upon an understanding of the heat and mass flows within the reservoir. In this paper, we present some general considerations for physical modeling as well as the results obtained from a laboratory model having two wells to simulate a geothermal energy extraction loop. (Author)

A76-33532 # Packed bed thermal storage models for solar air heating and cooling systems. P. J. Hughes, S. A. Klein (Wisconsin, University, Madison, Wis.), and D. J. Close (James Cook University, Townsville, Australia). *ASME, Transactions, Series C - Journal of Heat Transfer*, vol. 98, May 1976, p. 336-338. 9 refs. Contract No. E(11-1)-2588.

The infinite NTU ($NTU = h \text{ sub } nu \text{ AL} / mC \text{ sub } f$, where $h \text{ sub } nu$ = the volumetric heat transfer coefficient, A = the cross sectional area of the packed bed, L = the length of the packed bed in the flow direction and m = the mass flow rate of the fluid and $C \text{ sub } f$ is dimensionless) model for simulating gravel bed thermal storage models for solar air heating and cooling systems is described. The NTU model is compared with the Schumann model (which uses partial differential equations to describe the thermal performance of a paced bed with forced fluid flow) in terms of computing costs associated with the solution of model equations. It is shown that if one assumes NTU to be infinitely large, an accurate estimate of long-term thermal performance of the packed bed for most practical systems will be provided. B.J.

A76-33571 The production of hydrogen with the aid of solar energy (Herstellung von Wasserstoff mit Hilfe von Sonnenenergie). J. Nitsch (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für chemische Raketenantriebe, Hardthausen am Kocher, West Germany). *DFVLR-Nachrichten*, May 1976, p. 738, 739. In German.

An energy system which uses solar energy for a production of hydrogen constitutes an ideal solution of the energy crisis according to criteria related to the use of an inexhaustible energy source and the possibility to obtain the energy carrier from a cheap raw material which is available in sufficient quantities. A third criterion concerning an absence of waste products, except for waste heat, is also satisfied. The latter condition is not satisfied by a system employing nuclear energy. Approaches for the production of hydrogen are related to photolysis, electrolysis, thermochemical cyclic processes, the combination of thermochemical and electrolytic processes, and a modified photosynthesis. G.R.

A76-33873 Development of the satellite solar power station. P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *Spaceflight*, vol. 18, June 1976, p. 198-208. 9 refs.

An overview is given of the proposed course of development of a satellite solar power station (SSPS). The technologies under consideration for solar energy conversion, power transmission to earth, and transportation of the system or system components to orbit are discussed. A preliminary design for an SSPS based on single-crystal silicon solar cell arrays has been evolved. Two solar collector panels are designed to provide a power output of about 8500 MW, with an effective power output at the receiving antenna bus bar of about 5000 MW. Structural integrity is provided by a 100-meter diameter central mast and stiffened carried-through structure running through the assembly. Power is carried to microwave generators by structures which support the solar panels. A cross-field converter (Amplitron) with a platinum cathode operating on the principle of secondary emission to optimize lifetime is under consideration for converting dc to rf power at microwave frequencies. Potential transportation systems include the Space Shuttle, a modified Space Shuttle, or a fully reusable liquid oxygen/liquid hydrogen heavy-lift launch vehicle with a potential 400,000 lb payload capability to deliver into low-earth orbit. Ion propulsion could be used for transport of the fully assembled SSPS from low-earth to synchronous orbit. C.K.D.

A76-33909 Photoelectrochemical energy conversion and storage using polycrystalline chalcogen electrodes. G. Hodes, J. Manassen, and D. Cahen (Weizmann Institute of Science, Rehovot, Israel). *Nature*, vol. 261, June 3, 1976, p. 403, 404. 8 refs.

Corrosion-free photoelectrochemical cells have been developed and tested. The Cd-Se photoelectrode was prepared by electrolytic deposition on a conducting base, followed by treatment in an inert atmosphere. Corrosion of the photoelectrode was prevented by immersion in an aqueous solution of sulfide in which elemental sulfur had been dissolved. An activated carbon counter electrode was used. Storage of part or all of the converted energy was provided by a porous silver electrode which was isolated from the sulfur solution. Storage efficiencies of up to 90% have been demonstrated; however, significant improvements in conductivity are necessary. C.K.D.

A76-33910 Advanced turbine designs boost wind-power potential. T. W. Black (Hammond Farrell, Inc., New York, N.Y.). *Machine Design*, vol. 48, June 10, 1976, p. 26-28, 30-32.

A description is given of a number of novel approaches which can be employed to utilize wind energy. A device called a diffuser shroud makes it possible to double the efficiency of a simulated rotor. Another concept for increasing the power of wind turbine-generators is based on the concept of vortex augmentation. A German company has demonstrated that even lightweight wind turbine-generators can extract substantial amounts of power from the wind. An American company has developed wheel-like rotors with narrow rims and wire spokes. Rotors which spin on a vertical axis have the advantage that the rotor blades can accept the wind from any point of the compass. G.R.

A76-33957 # Principles of designing solar- and wind-energy systems (Printsipy postroeniia gelio- i vetroenergeticheskikh sistem). R. B. Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 1, 1976, p. 51-57. 15 refs. In Russian.

A systems analysis approach is proposed for planning and designing solar- and wind-energy systems whose operation involves natural, engineering, and human factors. Such relatively complex systems are characterized by the presence of control, functional objectives, a hierarchical system structure, and a continuously changing state of subsystems and elements. Computer-aided solutions to the problems of optimizing the system structure, the system parameters, and the system modes of operation are presented. V.P.

A76-33958 # Optimality criteria for solar- and wind-energy systems (O kriteriakh optimal'nosti gelio- i vetroenergeticheskikh sistem). R. B. Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 1, 1976, p. 58-63. 7 refs. In Russian.

It is shown that in order to design efficient solar- and wind-energy systems, it is necessary to define a goal function and to optimize the system with respect to two optimality criteria. One criterion is economic efficiency in the sense of least national-economy expenditures; the other is reliability in the sense of flawless performance probability. V.P.

A76-33959 # Some characteristics of the operation of a solar energy system as a low-potential heat source for heat pumps (Nekotorye osobennosti raboty solnechnoi ustanovki v kachestve nizkopotentsial'nogo istochnika tepla dlia teplovogo nasosa). O. L. Shvaleva and R. R. Avezov (Akademii Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 1, 1976, p. 64-66. In Russian.

A 'hot box' type solar energy system operating in combination with a heat pump is discussed. The effectiveness of water heating for the heat pump is analyzed for the period from October to March, assuming a water temperature of 35 C. The superiority of the system over a system without a heat pump is demonstrated. V.P.

A76-33960 # Questions associated with energy accumulation in solar power plants (Voprosy akumulirovaniia energii na solnechnykh energeticheskikh stantsiakh). R. R. Aparisi and D. I. Tepliakov (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). (*Sovmestnyi Sovetsko-Amerikanskii Seminar po Solnechnym Energeticheskim Stantsiim, Washington, D.C., June 28, 1974.*) *Geliotekhnika*, no. 2, 1976, p. 3-11. 10 refs. In Russian.

The principal prerequisites for developing daily, seasonal, and annual energy accumulators for solar power plants are discussed, and methods for processing long-time actinometric data as a basis for evaluating accumulator dimensions are proposed. Representative accumulator designs are examined from the point of view of their applicability in solar power plants. V.P.

A76-33961 # Economic efficiency of solar power plants (Ob ekonomicheskoi effektivnosti solnechnykh elektrostantsii). A. I. Filatov and D. Iu. Ibragimov (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *Geliotekhnika*, no. 2, 1976, p. 12-18. 5 refs. In Russian.

The limiting values of the technological and economical indices of solar power plants at which the latter would become compatible with conventional power plants are examined. Calculations carried out for desert and semidesert regions in Turkmen SSR, characterized by high transportation costs of fuel and coal, show that under such conditions solar power plants can compete with conventional ones. V.P.

A76-33962 # Concerning the use of identical standard facets in the construction of reflecting surfaces for solar collectors (K voprosu ispol'zovaniia fatset odnogo tiporazmera pri sozdaniia otrazhaiushchei poverkhnosti solnechnykh kontsentratorov). R. A. Zakh-

idov and Iu. A. Dudko (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektnoe Konstruktorsko-Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *Geliotekhnika*, no. 2, 1976, p. 19-21. In Russian.

A76-33963 # Allowance for solar radiation heat in the heat balance of a building during heating seasons, and savings in heating fuel (Uchet tepla solnechnoi radiatsii v teplovom balanse pomeshechniia v techenie otopitel'nogo perioda i ekonomii topliva na otoplenie zdani). A. B. Babaev and P. F. Rzaev (Azerbaidzhanskii Politekhnikeskii Institut, Baku, Azerbaidzhan SSR). *Geliotekhnika*, no. 2, 1976, p. 41-45. 5 refs. In Russian.

Calculations carried out for coastal and central regions of Azerbaidzhan, characterized by an average of 2211 and 2278 radiant hours per year, respectively, show that standard consumption of heating fuel can be substantially reduced through the use of solar heat. The savings in fuel consumption and in the cost of heating facilities are calculated on the basis of meteorological and solar-radiation data. V.P.

A76-34040 # Microwave energy converter with reversible magnetic field (O preobrazovatele SVCh-energii s reversivnym magnitnym polem). V. A. Bardenkov, V. A. Vauke, I. S. Gorshkov, and V. M. Lopukhin. *Radiotekhnika i Elektronika*, vol. 21, Apr. 1976, p. 821-828. 18 refs. In Russian.

The microwave energy converter described in this paper operates in the following way: the microwave signal enters a Cuccia resonator with a transverse magnetic field and imparts additional kinetic energy to the electron flux in the form of azimuthal rotation of the beam about the axis of the system. A reversible magnetic field changes its sign, thus converting the energy of beam rotation into additional longitudinal energy equal (at 100% conversion efficiency) to the energy of the microwave signal. A numerical analysis is performed on the conversion of the rotational energy of the beam to longitudinal energy and it is shown that the efficiency of this conversion can exceed 90% if the length of the reversible magnetic field region is equal to or greater than the cyclotron wavelength. B.J.

A76-34176 Economical design of wind generating plants. C. C. Johnson (Southwest Research Institute, San Antonio, Tex.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-12, May 1976, p. 316-320. 8 refs. Contract No. E(11-1)-2621.

A definitive analysis technique is proposed for designing wind generating plants to produce electrical energy at minimum cost. The method employs variation in essential design parameters: rated power level, rated wind velocity, design wind velocity, and number of generator poles. These parameters in turn define wind turbine radius, turbine speed, rated torque at step-up gear input, and step-up gear ratio. When these are combined with site (or region) specific wind statistics, appropriate wind plant cost functions and criteria by which to compute annual cost of ownership, the result yields the cost of produced energy for the several design variations. The selected design is that one for which the cost of produced energy is minimum. (Author)

A76-34198 Flower power - Prospects for photosynthetic energy. A. D. Poole (Institute for Energy Analysis, Oak Ridge, Tenn.) and R. H. Williams (Princeton University, Princeton, N.J.). *Bulletin of the Atomic Scientists*, vol. 32, May 1976, p. 48-58. 39 refs.

The possibility is investigated to utilize for the satisfaction of human energy requirements the solar energy which is stored in plants in connection with the photosynthesis process. It is pointed out that in the United States photosynthetic production on land is roughly comparable to total energy consumption. Approaches are examined for converting the plant biomass into suitable fuels, taking into account the formation of methane in biogasification and a production of methanol via pyrolysis. Aspects of the large-scale production of biomass are discussed. An important criterion in a selection of suitable land areas is related to the availability of sufficient water. Attention is also given to marine systems and the utilization of organic waste resources. G.R.

A76-34199 Tower power Producing fuels from solar energy. M. J. Antal, Jr. (Princeton University, Princeton, N.J.). *Bulletin of the Atomic Scientists*, vol. 32, May 1976, p. 58-62. 8 refs.

An investigation is conducted concerning the possibility to use a power tower for the production of hydrogen from organic matter. The power tower is a solar furnace which uses many flat, individually guided mirrors to reflect the sun's light to the top of a tower. The conversion process to be used is based on the pyrolysis of organic matter in a steam atmosphere. Suitable technological methods for implementing the considered process are examined and an economic analysis is conducted, taking into account a power tower pyrolysis facility located in the Midwest and using crop residues. It is concluded that under certain conditions the hydrogen obtained with the aid of the proposed approach could nearly compete with natural gas as a fuel at today's prices. G.R.

A76-34282 Series-resonant inverter for photovoltaic applications. L. L. Ogborn (Purdue University, West Lafayette, Ind.). In: *Power Electronics Specialists Conference*, Culver City, Calif., June 9-11, 1975, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 319-323.

This paper describes a single-phase, series-resonant inverter which injects a sinusoidal current into a load while a standard AC utility source is connected to the load and which can be used in photovoltaic applications. At moderate power levels the inverter requires DC input in the kilovolt range but will operate over a wide input voltage range. Control of the inverter is relatively simple and parallel operation with multiple DC sources with different DC input levels is easily accomplished. The circuit has no stand-alone capability at the present stage of development. (Author)

A76-34283 Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Seminar sponsored by the Society of Photo-Optical Instrumentation Engineers. Edited by Y. H. Katz (TRW Systems Group, Redondo Beach, Calif.). Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Volume 68), 1975. 192 p. S34.

The present collection of papers is concerned with problem-focused research on terrestrial applications of solar energy, with special emphasis on the development of viable options to meet a significant portion of the national energy needs in future years. These options include the utilization of solar energy for electrical power generation and the achievement of practical and economical use of solar energy for heating and cooling of buildings. Four broad topical areas are discussed: solar radiation data, instrumentation for solar radiation measurement, solar radiation collectors, and materials and materials research. Among the featured topics are solar energy microclimate as determined from satellite observations, problems in solar irradiance measurements, development of compound parabolic collector for photothermal and photovoltaic applications, and optical properties of materials as applied to flat plate solar collector design. S.D.

A76-34294 Current status and future prospects of non-tracking solar collectors. N. S. Kapany (Kaptron, Inc., Palo Alto, Calif.). In: *Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975.* Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 77-84.

The numerous potential applications of solar energy have been recognized widely for the past few decades. However, the sophisticated optical problems of an efficient collector, its integration with the overall system and the dominant economic constraints are not widely appreciated. This paper will briefly review the state-of-the-art of the non-tracking solar collectors with various performance criteria in mind. Also described in this paper are developments of some new components capable of producing high efficiency, lightweight and low cost non-tracking solar collectors. Windows with 'optical ribs' have been developed to yield high transmission, lightweight, ruggedness and efficient radiative and convective trapping. On the other

hand, a new component termed 'optical valve' has been developed which is capable of transmitting the incident solar radiation and reflecting back to the absorber much of the emitted infrared radiation. Furthermore, an embossed absorber is shown to achieve almost complete absorption of solar radiation at large angles of incidence. (Author)

A76-34295 The tower reflector as an alternate to the tower boiler concept for a central receiver solar thermal electric conversion plant. T. M. Knasel, R. T. Liner, J. Simmons (Science Applications, Inc., McLean, Va.), and R. Higgins (Science Applications, Inc., Albuquerque, N. Mex.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 85-96.

An investigation is conducted concerning the technological improvements possible for a presently considered central receiver solar thermal power generation plant. According to the current design concepts the sunlight received by arrays of second surface glass mirrors (heliostats) is reflected to a boiler atop a high tower. For a second generation system design it is proposed to place the boiler on the ground. The sunlight from the heliostats would be received by a secondary reflector at the top of the tower and be redirected to the boiler on the ground. Attention is given to aspects of heliostat design and operation, a nonimaging optical concentrator which is to be employed as an ideal light collector, aspects of receiver/boiler design, instrumental techniques, and test procedures. Reversible chemical reactions for power storage applications are also considered. G.R.

A76-34296 Performance of a 3.7 meter cylindrical concentrator. W. C. Livingston (Kitt Peak National Observatory, Tucson, Ariz.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 97-102. 9 refs.

Design and construction considerations are given for a 1.8 x 3.7 m cylindrical parabolic focusing collector having a concentration ratio = 28. Built of commonly available materials, this tracking collector is intended to feed, by the exchange medium of oil, an Abbot-type solar oven. At 80 C the collection efficiency is 0.33, declining to 0.05 at 260 C (500 F). The dependence of black coatings on receiver pipe efficiency is studied. The reflectivity of vacuum deposited aluminum, buffed aluminum plate and shiny aluminum foil are compared. The greatest improvement in performance has come about by placing the collector on a shade free roof. Abbot's mirror was shaded past 1 o'clock. (Author)

A76-34297 Mathematical model for the design of an optimum stationary solar energy collector. C. T. Gonzales and O. A. Arnas (Louisiana State University, Baton Rouge, La.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 103-111. 7 refs.

This is a general development of an equation to describe the optimum cavity-type stationary solar energy collector in two-dimensional space, and then the expansion into three-dimensional space. The intent is to establish a starting point for those who wish to do research in the area of concentrating collected solar energy. The final design of the collector is dimensionally optimized to collect and concentrate as much energy from the sun that is physically and economically feasible. (Author)

A76-34298 The FES Delta focusing solar collector. G. Falbel (Falbel Energy Systems Corp., Stamford, Conn.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 112-119.

This paper describes the design and measured performance

characteristics of a focusing solar collector that requires neither single nor dual axis tracking of the sun, but achieves solar concentration gains exceeding 2:1 for both direct and diffuse solar energy. Both sides of a conventional flat plate collector absorbing plate are used to collect solar energy using a compound cylindrical reflector and no thermal insulation is required in the collector. The focusing capability allows improved high temperature performance as compared to conventional flat plate collectors without requiring a selective absorber coating on the collector plate. Ray traces defining the collector's acceptance field of view for both direct and diffuse solar energy are presented, and the theoretical and experimentally obtained optical efficiency are compared. Measured results obtained from an instrumented prototype collector operating since February 1975 are presented, showing that a single collector collects approximately 50,000 Btus per average sunny day throughout the year. Applications of the collector as a transparent window or curtain-wall replacement in buildings are discussed, and large production quantity cost estimates are presented. (Author)

A76-34299 Solar power collector breadboard test program. N. S. Goralnick (Itek Corp., Lexington, Mass.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 120-127. NSF-supported research.

The design and economic feasibility of the Itek solar power collector approach for use in a solar-thermal-electric power plant are described, with special emphasis on the testing portion of the program. The system consists of five segmented collected mirrors which collect and focus the sun's energy within the absorber aperture, the solar flux being further concentrated on to the absorber rod located at the center of the absorber tube. In front of the absorber is a perforated aluminum sheet which attenuates the solar flux to establish a particular absorber rod temperature varying in the range from 430 to 1052 F. Located at the center of the absorber tube, in front of the attenuator, is a photocell assembly which develops the solar tracker error signal to power the motor that rotates the collector mirrors. The discussion covers hardware problems encountered, corrective measures adopted, performance measurement and evaluation, and results of a preliminary operational system cost analysis. Excellent potential for use in large-scale electric power generation and in total energy systems is demonstrated. S.D.

A76-34300 Comparative technical evaluation of solar collectors. P. J. Peters (Aerospace Corp., El Segundo, Calif.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 128-135. 7 refs.

A comparative technical evaluation of the four primary solar collecting configurations, namely, the central receiver, parabolic trough, paraboloidal dish, and 'Winston' collector, is made. Sub-system and overall efficiencies are presented, and technical descriptions and performance characteristics are discussed. Comparisons are made on a solar thermal conversion basis. Applicability of the 'Winston' collector for photovoltaic conversion is summarized. The most attractive candidate for solar thermal applications from a technical viewpoint is the central receiver configuration with the overall efficiency of 19.2%. The 'Winston' collector is more applicable for photovoltaic conversion than for solar-thermal conversion. (Author)

A76-34301 Development of the compound parabolic collector for photo-thermal and photo-voltaic applications. R. Winston (Chicago, University, Chicago; Argonne National Laboratory, Argonne, Ill.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975.

Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 136-144. 8 refs. ERDA-supported research.

Design and experimental tests of the compound parabolic

collector (CPC) concept for concentrating solar energy onto a receiver are described. Because of its wide angle of acceptance, the CPC can concentrate solar energy up to a factor ten without diurnal tracking of the sun, making it well suited for use in applications as a source of relatively high temperature (150-400 F) heat or an optical concentrator to reduce surface area requirements of photovoltaic cells. (Author)

A76-34302 Spectrally selective surfaces for high-temperature photothermal solar energy conversion. K. D. Masterson (Arizona, University, Tucson, Ariz.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 147-153. 27 refs.

For high temperature applications, selective surfaces which absorb the incident solar energy but suppress its thermal reradiation are shown to be most beneficial to solar energy converter systems using low or intermediate concentration ratios, although substantial economic savings can arise when used with large power systems having high concentration ratios. The optical performance and high temperature stability are discussed for coatings that rely on each of the five different methods for producing spectral selectivity. A coating that utilizes a silicon absorber over a silver reflector layer is described. The silicon is added by chemical vapor deposition (CVD) at temperatures greater than 600 C. This is a unique application for CVD and has the potential for large-scale production in a flow-through system. At 500 C the solar absorptance and total normal emittance for these coatings are 0.76 and 0.07, respectively. They have withstood lifetime testing for 1000 hours of cycling (2/h) between 150 C and 450 C, plus 100 H continuously at 600 C with little degradation. Future improvements should allow the entire stack to be fabricated by CVD and at the same time achieve increases in both optical performance and high-temperature durability. (Author)

A76-34303 Solar energy - Thin film coatings. R. M. Winegarner (Optical Coating Laboratory, Inc., Santa Rosa, Calif.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 154-160.

The shortfall between our nation's supply and demand for energy has created problems of critical proportions. One solution is to collect, retain, and utilize the energy of the sun. Thin films can be used to modify the amount of solar energy that is reflected, absorbed, or transmitted at various collector surfaces. Three types of films that have direct relation to solar energy are antireflection coatings (reflectance not greater than 2% per surface), selective absorber coatings (solar absorptance = 0.96, infrared emittance = 0.06), and transparent-low emittance coatings (transmittance = 8.5, emittance = 0.14). Studies have shown that through the use of coatings the performance of flat plate collectors can be improved as much as 12.5% and the performance of linear focusing collectors can be improved as much as 22.5%. The resultant changes in the economic viability of the collector systems indicate that the coatings can make a positive contribution to the solar energy collection systems. The implementation of these systems is close at hand and now is the time to press for development. (Author)

A76-34304 Development of ZrO_x/N_y/ films for solar absorbers. R. L. Lincoln, D. K. Deardorff, and R. Blickensderfer (U.S. Bureau of Mines, Albany Metallurgy Research Center, Albany, Ore.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 161-168. 20 refs.

For maximum effectiveness of solar-thermal conversion, a solar absorber must be a low emitter of thermal radiation. Thin film absorber stacks which possess such spectrally selective characteristics were developed by the Bureau of Mines. The stacks consisted of zirconium suboxide or subnitride absorber films on a reflective film

of silver or copper. The absorber films were prepared by reactively sputtering zirconium in argon with small amounts of oxygen, nitrogen, or both, or by oxidation of zirconium films in air. The solar absorptance and the thermal emittance were calculated from reflectance data. The solar absorptance ranged from 0.60 to 0.93 and the emittance at 600 K ranged from 0.024 to 0.28. Ratios of solar absorptance to thermal emittance extended from about 2 to 28. The stacks appear to be relatively stable under vacuum at temperatures up to about 600 K. (Author)

A76-34305 Cost-effective PbS-Al selective solar-absorbing panel. T. J. McMahon (U.S. Naval Weapons Center, China Lake, Calif.) and D. L. Stierwalt (U.S. Naval Electronics Laboratory Center, San Diego, Calif.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 169-171. 7 refs.

A PbS-Al solar panel which absorbs 0.90 of the incident solar energy at sea level while having a 258 C blackbody emissivity of 0.038 is described. This value has been achieved in a reproducible manner on aluminum-coated aluminum substrates with a single layer of PbS evaporated in standard vacuum to a thickness of 1100 Å. (Author)

A76-34306 * Practical anti-reflection coating for metal semiconductor solar cells. Y.-C. M. Yeh and R. J. Stirn (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Optics in solar energy utilization; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 172-177. 11 refs. Contract No. NAS7-100.

The metal-semiconductor solar cell is a possible candidate for converting solar to electrical energy for terrestrial application. A method is given for obtaining optical parameters of practical antireflection coatings for the metal-semiconductor solar cell. This method utilizes the measured refractive index obtained from ellipsometry since the surface to be AR coated has a multilayer structure. Both the experimental results and theoretical calculation of optical parameters for Ta₂O₅ antireflection coatings on Au-GaAs and Au-GaAs(0.78)P(0.22) solar cells are presented for comparison. (Author)

A76-34317 Energy on call. J. A. Casazza, T. R. Schneider, and V. T. Sulzberger (Public Service Electric and Gas Co.). *IEEE Spectrum*, vol. 13, June 1976, p. 44-47. 7 refs.

A public service study was conducted regarding the feasibility of energy storage for the electric power industry, taking into account the variations in the demand for power. The facilities for electric power generation and transmission are currently designed to meet peak demands. During off-peak periods, these facilities are, therefore, utilized below their full capacity. The economics of storage systems were studied for a 'peaking generation mode' and for an 'intermediate generation mode'. Attention was given to pumped hydro storage, thermal oil storage, thermal steam storage, compressed-air storage, lead-acid battery storage, advanced battery storage, hydrogen storage, flywheel storage, and superconducting magnetic energy storage. G.R.

A76-34319 Planning solar's future. G. Kaplan. *IEEE Spectrum*, vol. 13, June 1976, p. 54-59.

Investigations and developments related to a utilization of solar energy for the generation of electricity are considered. A description is presented of test and research projects concerned with the development of suitable wind-power generator systems. A significant contribution of photovoltaics to the generation of electric power depends on a substantial reduction in the cost of solar cells. Approaches for achieving the necessary cost reduction for solar arrays are discussed. Attention is also given to solar-thermal progress, the ocean-thermal energy-conversion status, and the concept of placing a large photovoltaic solar array in geosynchronous orbit. G.R.

A76-34324 Lignite refinement - A contribution to energy and raw material supply (Braunkohlenveredlung - Ein Beitrag zur Energie- und Rohstoffversorgung). P. Speich (Rheinische Braunkohlenwerke AG, Cologne, West Germany). *Brennstoff-Wärme-Kraft*, vol. 28, May 1976, p. 183-189. 13 refs. In German.

The available lignite resources in West Germany are considered together with questions regarding the utilization of this raw material, taking into account the conversion of lignite into solid, liquid, and gaseous hydrocarbons. Technological approaches for obtaining coke from lignite are examined and possibilities for use of lignite in metallurgical processes are investigated. A description is presented of the techniques and procedures which can be employed to obtain, with the aid of lignite, gaseous energy carriers, including methane, hydrogen, and a mixture of CO and hydrogen. The merits of various lignite refinement methods are compared, and utilization of the heat from nuclear reactors for the gasification processes is discussed. G.R.

A76-34325 Coal refinement (Kohlenveredlung). H.-D. Schilling (Steinkohlenbergbauverein, Essen, West Germany). *Brennstoff-Wärme-Kraft*, vol. 28, May 1976, p. 202-205. 96 refs. In German.

Coal-refinement processes, particularly those also involving utilization of nuclear energy, have a great economic potential according to the results of investigations published by the government of West Germany in 1975. Advances in the technology of coke production are reported. Attention is also given to developments which are concerned with the production of liquid hydrocarbons from coal. Technological approaches designed to satisfy environmental antipollution regulations are discussed along with installations for obtaining activated carbon. Improved coal-processing techniques are also described. G.R.

A76-34475 Energy cycles - Their cost interrelationship for power generation. S. Baron (Burns and Roe, Inc., Oradell, N.J.). *Mechanical Engineering*, vol. 98, June 1976, p. 22-30. 17 refs.

Energy generation and storage cycles are reviewed from the standpoint of the total cycle, encompassing energy yield and economy (net cost of base-load electric power considered over costs of the entire cycle) and ecological impact. The costs of source materials, processing of those materials, costs of transmission lines, power plants, and processing plants, and waste disposal must be taken into account. Total-cycle comparisons are made for electric power generated from petroleum, coal (direct firing with stack gas scrubbing, synthetic liquid fuels derived from coal, natural gas), uranium, fusion, and solar energy. Costs of materials and structures, and of pumped storage power plants, for solar energy cycles are considered. Preference is given to light-water reactors and liquid-metal fast breeders as most efficient and most economical, but the choice of model for waste disposal costs is not indicated. R.D.V.

A76-34501 Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Seminar sponsored by the National Science Foundation and Japan Society for Promotion of Science. Edited by T. Ohta (Yokohama National University, Yokohama, Japan). Yokohama, Japan, Yokohama National University, 1975. 346 p.

Advances in hydrogen production, storage, and transportation technology to meet future economic demands for a new energy source are outlined. Ample attention is devoted to hydrogen production by thermochemical and electrochemical systems as well as by solar energy, hydrogen storage and transportation by cryogenic and hydride systems, hydrogen energy systems, and hydrogen engine. Featured topics include efficiency of thermochemical production of hydrogen, hydrogen production via photosynthetic processes, hydrogen-fueled transport aircraft, and overview of the U.S. hydrogen energy systems technology study. The viability of the hydrogen-fueled internal combustion engine is demonstrated. S.D.

A76-34502 Efficiency of thermochemical production of hydrogen. K. Fueki (Tokyo, University, Tokyo, Japan). In: Key

technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975.

Yokohama, Japan, Yokohama National University, 1975, p. 35-43.

The thermal efficiency of processes in chemical industry is calculated using the units. It is shown that the efficiency of one step in a process is lower than 80%. With the assumption that the average thermal efficiency is 70%, the overall efficiencies of two-, three- and four-step processes are estimated to be about 50%, 35% and 25%, respectively. Higher efficiencies than that of water electrolysis would be attainable only in the thermochemical processes consisting of three steps or less. (Author)

A76-34503 A computer-aided search for thermochemical water-decomposition processes. K. Yoshida, H. Kameyama, and K.-I. Toguchi (Tokyo, University, Tokyo, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 45-54. 5 refs.

A computer-aided search method is proposed for determining thermodynamically feasible water-decomposition sequences to produce hydrogen and oxygen from water by means of heat energy discharged from a nuclear reactor. The discussion covers the thermochemical data necessary for computation, the basic search system, and the calculation procedure in each reaction step. In the three-step reaction sequences, water is the only raw material to be decomposed into hydrogen and oxygen, and all other reactants and products are recycled to act as catalysts. It is found that the number of possible reactions in each step is remarkably large even within limited reaction types. A list of reaction types, a block diagram to find three-step processes, and a flow diagram for calculation procedures are included. S.D.

A76-34504 Closed-cycle hydrogen production via CO₂ decomposition. S. Sato, Y. Ikezoe (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan), M. Takehisa (Japan Atomic Energy Research Institute, Watanuki, Gunma, Japan), and R. Ueda (Japan Atomic Energy Research Institute, Tokyo, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975.

Yokohama, Japan, Yokohama National University, 1975, p. 55-64. 12 refs.

Conversion of nuclear energy into chemical energy of hydrogen by water decomposition is examined on the basis of closed-cycle thermochemical and radiolytic decomposition of carbon dioxide. Particular attention is given to the decomposition of carbon dioxide by transition metal chlorides. The formation of carbon monoxide is analyzed for the reaction between carbon dioxide and dichlorides of manganese, iron, cobalt, and nickel, as well as chromium trichloride. Radiolytic yield of carbon monoxide from carbon dioxide with the additive propane as a reverse reaction retarder is considered for Co-60 gamma, reactor radiation, and fission fragment irradiation. The efficiency of radiolytic hydrogen production process is discussed. S.D.

A76-34505 Hybrid cycle with electrolysis using Cu-Cl system. M. Dokiya and Y. Kotera (National Chemical Laboratory for Industry, Tokyo, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 65-74.

A CuCl hybrid cycle is proposed to reduce the cell voltage of water electrolysis. The cycle involves two reactions: (1) $2\text{CuCl} + 2\text{HCl}$ yields $\text{H}_2 + 2\text{CuCl}_2$; and (2) $2\text{CuCl}_2 + \text{H}_2\text{O}$ yields $2\text{CuCl} + 2\text{HCl} + 1/2 \text{O}_2$. The first reaction is an electrolysis at room temperature, while in the second reaction CuCl_2 reacts with steam at more than 600 C to produce O_2 with complete recovery of CuCl and HCl . The electrolysis cell is divided into two compartments by an anion exchange membrane, where the cathode compartment is filled

with HCl and the anode compartment with CuCl and CuCl₂ in HCl solution. A platinum plate serves as anode and a copper plate as cathode, with the calomel electrode being used as the standard electrode. The apparatus used for the second reaction is an ordinary glass system with a recirculating pump. The merits of the proposed CuCl hybrid cycle suggest a reasonable possibility for hydrogen production. S.D.

A76-34506 Hydrogen production by the photocatalytic decomposition of water. H. Tamura, M. Murata, H. Yoneyama (Osaka University, Suita, Japan), H. Ikeda, and S. Murakami (Sanyo Electric Co., Ltd., Hirakata, Osaka, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 93-103. 5 refs.

Water photolysis is observed with TiO₂ powder exposed to the focused light of a 500-W xenon arc lamp corresponding to the band-gap energy of the rutile. TiO₂ powder is used instead of the single crystal for gas generation which evolved in the open-circuit regime. The rutile powder suspended in 1N H₂SO₄ is intermittently stirred with a magnetic stirrer, and analysis of the evolved gases is made by gas chromatography. It is shown that the local cell process of water decomposition takes place on an illuminated crystal with evolution of more oxygen than hydrogen. In particular, hydrogen and oxygen evolution occur simultaneously, although the rates are very low. S.D.

A76-34507 Water-splitting system hybridised by photochemical and thermoelectric utilization of solar energy. T. Ohta (Yokohama National University, Yokohama, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 105-111. 7 refs. Research sponsored by the Ministry of Education and Ministry of International Trade and Industry.

Hybrid cycles in a photochemical flat cell combined with Fresnel lens and exposed to a solar beam are examined. The heat collected through the lens is converted to electric energy by means of a thermoelectric system. The chemical product and water are electrolyzed to produce hydrogen and oxygen while keeping other materials on a cycle. The final photochemical reaction is identified as $2\text{Fe}(2+) + \text{I}_3(-) + \text{light} = 2\text{Fe}(3+) + 3\text{I}(-)$. The overall efficiency is found to vary between 15 and 25%. S.D.

A76-34508 Hydrogen-oxygen utilization devices. W. J. D. Escher (Escher Technology Associates, St. Johns, Mich.). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 113-123.

The paper introduces the concept of the hydrogen-oxygen utilization device as a class and provides a general characterization by way of citing several examples. The supporting technological basis for hydrogen-oxygen systems, especially that deriving from the rocket engine development field, is outlined. Attention is focused on hydrogen-oxygen rocket engine and fuel cell development, process steam production, electricity generation employing combustion-produced steam, and vehicular power systems. The benefits derived are in the environmental, efficiency, cost, weight and size, and general operational areas. A technological basis exists for future developments, especially as a result of the progress achieved in the aerospace field. S.D.

A76-34509 Metal hydride storage for mobile and stationary applications. K. C. Hoffman, J. J. Reilly, F. J. Salzano, C. H. Waide, R. H. Wiswall, and W. E. Winsche (Brookhaven National Laboratory, Upton, N.Y.). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan,

Yokohama National University, 1975, p. 157-200. 22 refs.

One factor that limits the direct use of hydrogen as a fuel is the difficulty of safe economical storage. An attractive alternative to conventional storage methods is the storage of hydrogen as a metal hydride due to the fact that many hydrides contain more hydrogen per unit volume than liquid hydrogen. The most pertinent properties of hydrides derived from rare earth, iron-titanium, and magnesium alloys are described, along with special applications to mobile and stationary storage. It is shown that iron-titanium and magnesium alloys are highly promising hydride storage media, the former for stationary applications and the latter for mobile applications. Results of recent work on hydrogen storage development and engineering design of storage systems are reviewed. S.D.

A76-34510 The thermochemical studies in N.C.L.I. Y. Kotera (National Chemical Laboratory for Industry, Tokyo, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 201-203.

The paper outlines the thermochemical reactions pertaining to the recovery of hydrogen from H₂S cycle, SO₂ cycle, CuCl hybrid cycle, and Ca-I cycle. The most active catalyst for the direct decomposition of H₂S is found to be molybdenum sulfide. Substitution of quinone for iodine in the SO₂ cycle is discussed. The merits of the CuCl hybrid cycle suggest a reasonable possibility for hydrogen production. The reactions involved in the Ca-I cycle are identified, but determination of relevant conditions is under investigation. S.D.

A76-34511 An assessment on the transition to hydrogen energy systems. S. Ihara and S. Wakamatsu (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 227-242. 6 refs.

The paper is concerned with a projection of energy demand and supply in Japan for the last quarter of this century, the potential capability of hydrogen in the projected energy situations, and the cost of a hydrogen energy system with hydrogen as an energy carrier similar to electricity. A water electrolysis system using geothermal power and/or off-peak nuclear power could well be adopted for hydrogen production in the near future. However, considerable research and development should be conducted to create a new production system with an overall efficiency not less than 40%. S.D.

A76-34512 * Experimental results with hydrogen fueled internal combustion engines. P. C. T. de Boer, W. J. McLean, and H. S. Homan (Cornell University, Ithaca, N.Y.). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 243-254. 14 refs. Research sponsored by the U.S. Department of Transportation and NASA.

The paper focuses on the most important experimental findings for hydrogen-fueled internal combustion engines, with particular reference to the application of these findings to the assessment of the potential of hydrogen engines. Emphasis is on the various tradeoffs that can be made, such as between maximum efficiency, maximum power, and minimum NO emissions. The various possibilities for induction and ignition are described. Some projections are made about areas in which hydrogen engines may find their initial application and about optimum ways to design such engines. It is shown that hydrogen-fueled reciprocal internal combustion engines offer important advantages with respect to thermal efficiency and exhaust emissions. Problems arising from preignition can suitably be avoided by restricting the fuel-air equivalence ratio to values below about 0.5. The direct cylinder injection appears to be a very attractive way to operate the engine, because it combines a wide range of possible power outputs with a high thermal efficiency and very low NO emissions at part loads. S.D.

A76-34513 **Combustion improvement in hydrogen fueled engine.** S. Furuhashi (Musashi Institute of Technology, Tokyo, Japan), K. Yamane (Nissan Motor Co., Ltd., Tokyo, Japan), and I. Yamaguchi (Japan Automotive Research Institute, Ibaraki, Japan). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 255-284.

Abnormal combustion in a hydrogen-fueled reciprocal internal combustion engine associated with preignition and backfire as well as with excessive NO_x formation is examined. Results are presented for an experimental investigation on engine modifications relative to compression ratio, spark plug, EGR, intake air throttle, hydrogen injection, and hydrogen-oxygen combustion. A combined process of premixture and high-pressure hydrogen injection into the combustion chamber is developed which yielded improved results with respect to power output and NO_x formation. Results are also presented for a high-speed modified version of the experimental engine tested. S.D.

A76-34514 * **Hydrogen energy systems technology study.** J. H. Kelley (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 303-314.

The paper discusses the objectives of a hydrogen energy systems technology study directed toward determining future demand for hydrogen based on current trends and anticipated new uses and identifying the critical research and technology advancements required to meet this need with allowance for raw material limitations, economics, and environmental effects. Attention is focused on historic production and use of hydrogen, scenarios used as a basis for projections, projections of energy sources and uses, supply options, and technology requirements and needs. The study found more than a billion dollar annual usage of hydrogen, dominated by chemical industry needs, supplied mostly from natural gas and petroleum feedstocks. Evaluation of the progress in developing nuclear fusion and solar energy sources relative to hydrogen production will be necessary to direct the pace and character of research and technology work in the advanced water-splitting areas. S.D.

A76-34515 **Hydrogen as an automotive fuel.** W. D. Van Vorst and J. G. Finegold (California, University, Los Angeles, Calif.). In: Key technologies for the hydrogen energy system; Proceedings of the U.S.-Japan Joint Seminar, Tokyo, Japan, July 20-23, 1975. Yokohama, Japan, Yokohama National University, 1975, p. 315-328. 19 refs.

A comparison is drawn between the combustion properties of hydrogen and other fuels, with particular reference to the advantages and disadvantages of hydrogen as an engine fuel. The most significant of the several attributes of hydrogen as an automotive fuel appears to be the wide range of flammability (or ignition) limits. Methods of solution for the problem of preignition backfire are outlined. Actual operating experience indicates that a cryogenic liquid hydrogen fuel system is a viable on-board storage concept for the hydrogen-fueled vehicle. Hydrogen offers the possibility of essentially pollutant-free operation at high thermal efficiency with an inherent safety no more hazardous than other high-energy fuels. S.D.

A76-34812 **Fresh breeze for Denmark's windmills.** D. Hinrichsen and P. Cawood. *New Scientist*, vol. 70, June 10, 1976, p. 567, 568, 570.

Recommendations of the Danish Academy of Sciences Wind Committee Report are discussed. Comparison of production data from an existing windmill at Gedser, Denmark with output data from the U.S. Zion 1 nuclear power plant shows that the power availability of such a windmill equipped with a hypothetical device capable of storing 24 hours' average power output is comparable to that of the Zion 1 reactor. Links with the Swedish and Norwegian

power networks, which have large hydroelectric capacities and 'pumped storage' capability, offer a good solution to the problem of wind availability, since the period of lowest wind activity in Denmark corresponds to the late spring runoff in Northern Scandinavia. A \$9 million wind development program, including construction of large electricity-producing mills and smaller mills for heat production, has been proposed. A 50 m high variable-blade windmill capable of producing up to 3600 MWh/yr is under construction at Tvind and may be linked with the electrical supply grid upon completion. C.K.D.

A76-34814 **Fusion research. I - What is the program buying the country.** W. D. Metz. *Science*, vol. 192, June 25, 1976, p. 1320-1323.

A critical analysis is presented of current and proposed programs of magnetic fusion research. It is argued that present emphasis placed by the Energy Research and Development Administration (ERDA) on Tokamak reactors, including construction of the \$225 million Tokamak Fusion Test Reactor at Princeton and a proposed \$9 billion program leading to the introduction of a machine generating about 10 megawatts, drains funds and interest from potentially promising alternatives. These include Tormac, Z-pinch, and Laser-Heated Solenoid reactors. A principal alternative to the Tokamak under consideration by the ERDA is a high-beta (ratio of plasma pressure to magnetic field pressure) open-ended system in which the magnetic fields are configured in such a way as to partially reflect plasma escaping at the ends back into the machine. C.K.D.

A76-35139 **Uses and promises of solar energy (Utilisations et promesses de l'énergie solaire).** J. R. Vaillant. Paris, Eyrolles, Editeur, 1976. 366 p. 177 refs. In French. \$32.50.

The book covers solar energy measurements, the impact of the energy crisis; trapping, conversion, and utilization of solar energy; household use of solar energy; solar energy costs on an industrial scale; architecture of large and small buildings for best utilization of solar energy; and solar energy in the urban environment. Specific topics include: storage of solar energy, direct photothermic conversion, electric power generation, water heaters, space heating, refrigeration, thermal pollution by solar power, the urban microclimate, floating islets, and solar cities. Solar-powered kitchens and cooking equipment, future electrosolar power units, concentrating mirrors, antiradiation structures, and weather modification by solar power are also discussed. R.D.V.

A76-35145 **The efficiency of district heating gas turbine installations.** B. V. Sazanov (Moskovskii Energeticheskii Institut, Moscow, USSR). (*Teploenergetika*, vol. 22, Feb. 1975, p. 49-54.) *Thermal Engineering*, vol. 22, Feb. 1975, p. 51-57. Translation.

The specific features of gas turbine heat-producing plants and of heat transmission from them, which determine the conditions of their efficient operation, are enumerated. These are: (1) the high temperatures (350-500 C) for the supply and removal of heat; (2) steam and hot water supply from the plant in the form of exhaust gas heat; (3) the relatively weak dependence of the power characteristics of a plant on its unit capacity; (4) low costs and economic viability at loads of 100-500 Gcal/h and even lower; (5) exhaust gas heating of the steam generators at temperatures in excess of 400-500 C; and (6) heat-boosting of the steam generators and network water heaters by additional firing. A method for examining the fuel saving of a given district gas turbine installation is examined. B.J.

A76-35225 **Solar heating and cooling: Engineering, practical design, and economics.** J. F. Kreider (Environmental Consulting Services, Inc., Boulder, Colo.) and F. Kreith (Colorado, University; Environmental Consulting Services, Inc., Boulder, Colo.). Washington, D.C., Scripta Book Co.; New York, McGraw-Hill Book Co., 1975. 350 p. 106 refs. \$22.50.

It is the purpose of the book to provide the architect, engineer, and builder with the tools required to design and construct properly engineered solar heating and cooling systems. Fundamentals of heat

transfer are examined and the methods of solar-energy collection and use are considered, taking into account combined heat-transfer mechanisms, solar-radiation principles, the characteristics of a solar collector with a wavelength selective surface, flat-plate solar-collector performance, and solar cells for direct conversion of solar energy to electric power. Attention is given to heating and cooling requirements, aspects of collector design, the storage of energy at high and low temperatures, vapor-compression systems and heat pumps, and the economics of solar air conditioning. (G.R.)

A76-35248 Inverters for commercial fuel cell power generation. G. A. Phillips, J. H. Vogt, and J. W. Walton (United Technologies Corp., South Windsor, Conn.). (*Institute of Electrical and Electronics Engineers, Winter Power Meeting and Tesla Symposium, New York, N.Y., Jan. 25-30, 1976.*) *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-95, May-June 1976, p. 944-953. 11 refs.

This paper describes the results of work accomplished in developing low cost, high efficiency dc to ac power conversion equipment for fuel cell powerplants to be used in two different commercial applications. The first is for on-site power generation in the range of 10 to 500 kW and the second is for dispersed electric utility power generation in substations at a 26 MW power level. Performance data is presented on single-phase and three-phase prototype inverters in the first category. Work currently in progress

A76-35665 Ocean Thermal Energy Conversion - A significant solar resource. J. G. McGowan (Massachusetts University, Amherst, Mass.). *Solar Energy*, vol. 18, no. 2, 1976, p. 81-92. 25 refs. NSF Grant No. GI-34979.

This paper presents the general concepts for Ocean Thermal Energy Conversion, a large-scale solar-energy-driven system, and summarizes the most recent systems-design work on the subject. The systems and components of various investigators are compared, and the environmental and economic aspects of such power systems are discussed. (Author)

A76-35666 Comparison of solar concentrators. A. Rabl (Argonne National Laboratory, Argonne, Ill.). *Solar Energy*, vol. 18, no. 2, 1976, p. 93-111. 32 refs.

In order to help provide a rational basis for deciding which concentrator type is best suited for a particular application, a variety of solar concentrators is compared in terms of their most important general characteristics, namely, concentration, acceptance angle, sensitivity to mirror errors, size of reflector area, and average number of reflections. The connection between concentration, acceptance angle, and operating temperature of a solar collector is analyzed in simple intuitive terms, leading to a straightforward recipe for designing collectors with maximal concentration (no radiation emitted by the absorber must be allowed to leave the concentrator outside its acceptance angle). Several proposals are made, including the use of compound parabolic concentrators as second-stage concentrators for conventional parabolic or Fresnel mirrors. Such a combination approaches the performance of an ideal concentrator without demanding a large reflector; it may offer significant advantages for high-temperature solar systems. (Author)

A76-35667 A design procedure for solar heating systems. S. A. Klein, W. A. Beckman, and J. A. Duffie (Wisconsin University, Madison, Wis.). (*International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.*) *Solar Energy*, vol. 18, no. 2, 1976, p. 113-127. 29 refs.

This paper is concerned with the design of solar space and water heating systems for residences. A simulation model capable of estimating the long-term thermal performance of solar heating systems is described. The amount of meteorological data required by the simulation in order to estimate long-term performance is investigated. The information gained from many simulations is used to develop a general design procedure for solar heating systems. The result is a simple graphical method requiring monthly average

meteorological data which architects and heating engineers can use to design economical solar heating systems. A method of estimating the monthly average radiation on tilted surfaces is included. (Author)

A76-35669 Performance and optimization of a cylindrical-parabola collector. P. Singh and L. S. Cheema (Punjab Agricultural University, Ludhiana, India). (*International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.*) *Solar Energy*, vol. 18, no. 2, 1976, p. 135-141. 8 refs.

This paper includes an analysis of the performance of a cylindrical-parabola collector in terms of the amount of energy collected, optimization of its various parameters, and experimental verification of theoretical predictions. A literature review reveals that the aperture of the reflector is a more logical choice as a characteristic dimension than the focal length. Theoretical concentrations for various absorber shapes have been recalculated with relatively more logical assumptions. The heat balance on the absorber showed that the dimensionless temperature (ratio of the absorber temperature to the stagnation temperature) completely predicts the performance of the collector. This is so because the stagnation temperature is a unique function of all variables (except the temperature of the absorber) of the collector assembly. To corroborate the theoretical predictions, a cylindrical-parabola collector capable of two-axis steering was constructed. Provision was made for changing the relative focal length, theoretical concentration, and flow rate of the heat-transfer fluid. Three types of data concerning maximum collectable energy, efficiency at different absorber temperatures, and stagnation temperature were obtained. The theoretical curve and the experimental results have been compared in a certain range of the dimensionless temperature. The agreement is satisfactory. (Author)

A76-35670 * Evaluation of the flat-plate solar collector system for electric power generation. R. E. Athey (Black and Veatch, Consulting Engineers, Kansas City, Mo.). (*International Solar Energy Society, Meeting, Fort Collins, Colo., Aug. 1974.*) *Solar Energy*, vol. 18, no. 2, 1976, p. 143-147. Contract No. NAS3-18014.

This evaluation of the flat-plate collector system was designed to determine the number of flat-plate collectors required to generate a given amount of electricity with optimum efficiency. Variable parameters are the temperature of the heat-transport fluid, both to and from the collector field. In the analysis, the efficiency of the flat-plate collectors was coupled to the efficiency of the thermal cycle to calculate optimal overall system efficiencies. Overall system efficiencies for the system are on the order of 3.5 per cent or less. Over two million 4 ft-by-4 ft collectors would be required to produce 100,000 kW(e). Based on the results, it can be shown that the limiting factor in the use of the flat-plate collector system for electric power generation is the efficiency of the collectors. An increase in the overall system efficiency can occur only if the collector efficiency can be increased at higher surface temperatures. (Author)

A76-35671 A hybrid solar air conditioning system. F. A. Costello (Delaware University, Newark, Del.). *Solar Energy*, vol. 18, no. 2, 1976, p. 149-152. 5 refs.

A hybrid solar air-conditioning system is proposed which is partly an absorption system and partly a vapor-compression system. Two configurations are considered: lithium bromide/water systems with either a water-cooled absorber and condenser (chilling water) or an air-cooled absorber and condenser (chilling air). The costs of the various subsystems are estimated so that some preliminary designs can be devised. The performance of both configurations is analyzed, and several modifications are discussed. The cost estimates show that the hybrid unit is economically competitive with previously proposed solar and nonsolar systems if the collector is used for both summer cooling and winter heating. A distinct cost advantage is noted for the air-cooled configuration. F.G.M.

A76-35672 The Winston solar concentrator described as an ellipse. J. S. Canning (U.S. Navy, Naval Surface Weapons Center, Dahlgren, Va.). *Solar Energy*, vol. 18, no. 2, 1976, p. 155, 156.

The Winston solar concentrator is usually described as having a plane profile curve of a parabola. It is shown analytically that the form for a Winston concentrator can be better described as an ellipse. An equation is derived which relates the shape of the ellipse to the concentration via the light-acceptance angle. A partial list of such relationships is presented, and it is noted that the ratio of the semimajor axis to the semiminor axis is the concentration ratio plus one. F.G.M.

A76-35680 # On the possible use of a solar-electric power plant in residential dwellings. J. T. Pytlinski (Florida, University, Gainesville, Fla.). *Archivum Termodynamiki i Spalania*, vol. 6, no. 4, 1975, p. 567-582. 26 refs.

The plant arrangement and anticipated performance of a solar-electric power plant for residential dwellings is discussed. A short review of the best known methods of indirect conversion of solar energy into electrical power is presented. An alternative solution of ac or dc power generation is taken into consideration. The main components - prime mover, generator/alternator, electrochemical energy storage and control circuit - are discussed in detail. Data concerning various working fluids based upon cycle temperatures and pressures are presented in tabular form. A typical cycle diagram for one of the working fluids is also presented. Economic factors governing the total cost of a solar-electric power plant and the cost to customers of electric power produced via solar energy are briefly discussed. (Author)

A76-35750 # Energy conversion efficiency of thermionic converters of small output power (Der Wirkungsgrad thermionischer Konverter kleiner Ausgangsleistung). C. Schmieder (Rostock, Universität, Rostock, East Germany). *Zeitschrift für elektrische Informations- und Energietechnik*, vol. 6, no. 2, 1976, p. 121-128. 19 refs. In German.

The maximal energy conversion efficiency of a cylindrical cesium thermionic converter is studied as a function of emitter temperature (in the range 1400-2800 K), taking account of heat transfer between collector and emitter. This analysis is used to calculate the relation between maximal conversion efficiency and maximal output power for thermionic converters with outputs of less than 30 W. B.J.

A76-35751 Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Workshop sponsored by the National Science Foundation. Edited by H. P. Harrenstien (Miami, University, Coral Gables, Fla.). Coral Gables, Fla., University of Miami, 1975. 238 p. \$30.

Some technology limitations on ocean thermal power plants were discussed, and a progress report on a working model of a closed cycle ocean power plant was presented. Site selection for an ocean power plant off Hawaii was discussed, and a progress report on ocean power plant research at the University of Massachusetts was presented. A large part of the workshop was devoted to various aspects of heat exchangers for ocean power plants. Other topics considered were anti-corrosion and anti-biofouling design, economic and environmental considerations in power plant design, and marine technology. B.J.

A76-35752 # The National Ocean Thermal Energy Conversion program. R. Cohen (ERDA, Div. of Solar Energy, Washington, D.C.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 14-21.

The United States Ocean Thermal Energy Conversion program is reviewed. The overall objective of the program is to establish the technical and economic viability of large-scale ocean systems capable of converting ocean heat into electric power. The specific objectives

are to: (1) establish design and evaluation criteria for components and subsystems; (2) perform mission studies and system analyses examining technical and economic feasibility; (3) investigate possible barriers to technology implementation; (4) explore energy conversion, storage, and delivery systems; and (5) study potential by-products of ocean power plants. The Program Solicitation, requesting proposals in two basic categories - engineering evaluation of available concepts and advanced research on key problems - is described. B.J.

A76-35753 # A general design strategy approach to ocean thermal plants. C. Zener (Carnegie-Mellon University, Pittsburgh, Pa.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings.

Coral Gables, Fla., University of Miami, 1975, p. 23-27.

A block diagram is presented for the functional design of an ocean thermal power plant, the goal of which is to obtain electric power at a minimum capital cost per unit power output. The design scheme adopts the closed cycle approach of D'Arsonval, although other approaches could also be used. It is shown that specifications for the individual components must satisfy two requirements: (1) the specifications must be self-consistent so that the components may be integrated into a complete system; and (2) they must be such as to minimize the total cost of the system. This problem of integration is illustrated by a simple system, considering only the costs of the heat exchangers and the pumps. B.J.

A76-35754 # Some technology limitations on practical ocean at power plants. W. E. Heronemus and J. G. McGowan (Massachusetts, University, Amherst, Mass.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 28-54.

Two overriding problem areas which must be overcome for the concept of ocean thermal power plants to succeed - corrosion and biofouling - are discussed. The controlling technology problems for which steadily improved solutions must be sought are summarized: (1) the turbines must achieve component efficiencies of at least 90%; (2) the heat exchangers must be designed to achieve high rates of heat transfer at least possible costs in invested material; (3) supply of both hot and cold water at a site without disruptions of the material thermal layering of the ocean must be assumed; (4) the structure required to convey the huge quantities of cold water is a major problem area; (5) the mooring and anchor systems for plants located in swift currents will be larger and heavier than any before; (6) the problem of steel-reinforced concrete for ocean use; and (7) the costs of the energy umbilicals, whether electricity, hydrogen, ammonia or some other energy product flows, are large. B.J.

A76-35755 # Research on an engineering evaluation and test program. A. Griffin (TRW, Inc., Redondo Beach, Calif.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 58-66.

Certain aspects of research devoted to the development of ocean thermal power plants are discussed. Technical and economic feasibility of the power plants and the design of a related test program are considered. The research is divided into three principal areas: systems analysis, global marine studies, and engineering and construction of power plants. The key issues - heat exchanger technology, the cold water pipe, mooring and positioning, and biofouling, are examined, and the project schedule is provided. B.J.

A76-35756 # Nearshore application for an ocean thermal energy conversion pilot plant in Hawaii. K. H. Bathen (Hawaii, University, Manoa, Hawaii). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 67-72, 75-79; Discussion, p. 72-74.

The paper aims to assess potential sites in Hawaii for the nearshore applications of an ocean thermal power plant, with emphasis on environmental and socio-economic repercussions.

Several categories of data have been examined, including bathymetric information, bottom character observations, water quality data, a limited amount of bio-data, and circulation and sea state data. The two areas under consideration are Keahole Point and Keauolu Point. The legal aspects of a power plant in the coastal zone are considered together with a study whose aim is to establish a profile of the baseline socio-economic conditions in the Kailua-Kona area and the design of an econometric model. B.J.

A76-35757 # Progress Report of OTEC research at the University of Massachusetts. J. G. McGowan and W. E. Heronemus (Massachusetts, University, Amherst, Mass.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 80-89.

The new Mark II ocean thermal power plant configuration, an improvement on the 1973 baseline configuration Mark I, which was a twin hull catamaran type system with natural flow boilers, is described. Mark II uses propane as a working fluid, plate-fin heat exchangers, and both hot and cold resource water pumping. A preliminary cost estimate for the 400 MW Mark II configuration was presented and a complete cycle study of a 100 MW gross output ocean thermal power plant was completed. A list of twelve conclusions relating to engineering, environmental, and marine aspects of ocean thermal power plants is presented. B.J.

A76-35758 # Progress report on solar sea power plants. A. Lavi (Carnegie-Mellon University, Pittsburgh, Pa.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 90-94, 96-99; Discussion, p. 94, 95. NSF-sponsored research.

Aspects of the analytical and functional design of the ocean thermal power plants program at Carnegie-Mellon University are reviewed. Particular attention is paid to heat exchangers, rotating electrical machinery, pumps, and cold water intakes. A sketch of the solar sea power plant is provided together with one of a modularized heat exchanger. B.J.

A76-35759 # Heat exchangers and optimum design for solar sea power plants. A. Lavi (Carnegie-Mellon University, Pittsburgh, Pa.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 101-110, 119, 121-125; Discussion, p. 111, 112.

The selection of an optimal heat exchanger for a solar sea power plant is discussed. A considerable improvement in the heat transfer coefficient is achieved by coating a suitable, working-fluid-dependent porous material on the heat exchange surface for the evaporation. It is shown that considerable heat transfer improvement for condensation could be achieved by using corrugated surfaces. A table is presented describing the effect of corrugated surfaces on evaporation for the case of different working fluids and identical design of evaporator and condenser. B.J.

A76-35760 # Heat exchangers for ocean thermal power plants. F. Notaro (Union Carbide Corp., Linde Div., Tonawanda, N.Y.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 126-130, 133-145; Discussion, p. 130-132.

The nucleate boiling heat transfer surface developed by Linde for ocean thermal power plants is described. Current heat exchanger design practice is illustrated by an exchanger tube bundle 6 to 7 ft in diameter and 30 to 40 ft long. Heat exchanger performance (e.g., pressure drops, seawater temperature changes, etc.) is proposed as a function of some key parameter (e.g., seawater flowrate). Tables are presented describing the preliminary design of an evaporator for a 110 MW plant. The key problems confronting heat exchanger technology - life, corrosion, cleaning biofoulants, and plugging leaky tubes - are summarized. B.J.

A76-35761 # Plastic heat exchangers for sea solar plants. E. N. Sieder (DSS Engineers, Inc., Fort Lauderdale, Fla.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 149-158.

A plastic heat exchanger for ocean thermal power plants whose design depends on the flow of the Gulf Stream across the tubes of the evaporator to give the necessary velocity to enhance heat transfer is described. Another plastic exchanger considered uses forced circulation of the warm seawater through enclosed boilers. The boilers are of the horizontal tube, spray film design with the warm sea water pumped through the tubes and the working fluid sprayed over the top of the bundles. The tube bundles of the boiler will be mounted in two sections: one on top of the boiler, with a space in between for intermediate vapor removal and additional spray nozzles for condensate recirculation. Evaporator heat transfer coefficients and pressure drops were calculated for the water side. B.J.

A76-35762 # Heat exchangers for sea solar power plants. B. King (Miami, University, Coral Gables, Fla.). In: Ocean Thermal Energy Conversion Workshop, 2nd, Washington, D.C., September 26-28, 1974, Proceedings. Coral Gables, Fla., University of Miami, 1975, p. 159-166.

The most obvious problems in the design of heat exchangers for ocean thermal power plants are summarized and some of the solutions suggested for them are discussed. Modular construction of heat exchangers is examined, with emphasis on reliability, availability, and maintainability of components. A drawing is presented showing the most important characteristics of heat exchangers for ocean power plants. The operating conditions of heat exchangers are summarized: small temperature gradient, fouling and corrosion, hydrostatic pressure, buoyancy, and current. Design features are considered: use of aluminum, use of plastics, pressure balancing, buoyant support, and current pumping. B.J.

A76-35796 Fusion research. II - Detailed reactor studies identify more problems. W. D. Metz. *Science*, vol. 193, July 2, 1976, p. 38-40, 76.

The article discusses controlled fusion as an energy source with particular reference to the tokamak configuration of the University of Wisconsin - the UWMAK-I. Topics touched upon include reactor design and size and radiation damage. Particular attention is paid to the short wall life of the tokamak reactor, to refueling and impurities and to the problem of radioactive wastes. B.J.

A76-35889 Solar concentrators with maximal concentration for cylindrical absorbers. A. Rabl (Argonne National Laboratory, Argonne, Ill.). *Applied Optics*, vol. 15, July 1976, p. 1871-1873. 9 refs. ERDA-supported research.

The differential equation is derived that describes the reflector of an ideal two-dimensional radiation concentrator with an absorber of arbitrary convex shape. For the special case of an absorber with circular cross section, the equation can be solved in closed form if suitable coordinates are used. The effect of absorption at the reflector is considered, and formulas are presented for determining the attenuation of radiation on its passage from aperture to absorber. (Author)

A76-36048 The Huntorf air-storage gas turbine power station of the Nordwestdeutsche Kraftwerke AG (Das Luftspeicher-Gasturbinenkraftwerk Huntorf der Nordwestdeutsche Kraftwerke AG). O. Weber. *Motortechnische Zeitschrift*, vol. 37, June 1976, p. 235, 236, 245, 246. In German.

The paper describes the basic operation principle and general design of the world's first air-storage gas turbine power station, presently under construction and planned to deliver 290 MW by mid-1977. In an air-storage gas turbine the processes of compression and expansion of the air working medium are separated in time, making the whole turbine output available as useful power, while with conventional gas turbines only one-third of the turbine power is available. The compressor is driven by a motor drawing its energy

from the electric main power supply. At night, for example, the compressor will operate on the electric power, at the same time sucking in air and storing it at high pressure. At peak loads this air is drawn out and heated by the burning of fuel and expanded in the turbine. Useful work is 20-40% greater than the pump work, while with the conventional hydraulic pump storage power plants the useful work is about 25% smaller than the pump work. P.T.H.

A76-36094 Economic and environmental balancing in response to NEPA for electric power generating plants. M. Bender (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Nuclear Engineering and Design*, vol. 36, no. 3, 1976, p. 299-314.

Discussion of principles that can provide guidance in responding to the National Environmental Policy Act (NEPA) in the planning of electric power generating plants. The environmental assessment procedure described is initiated by considering alternative decisions in concern for environmental assessment. Having defined the decision paths, the assessment proceeds in a four-phase sequence: Correlation of the alternatives with resource and marketing restraints; screening the alternatives for environmental adequacy and specifying the needed technological refinement; examination of the economics in terms of energy costs; comparing the energy cost with the environmental index and selecting the combination that best reflects the current social preference. (Author)

A76-36403 Status of coal gasification. D. A. Tillman (Materials Associates, Inc., Washington, D.C.). *Environmental Science and Technology*, vol. 10, Jan. 1976, p. 34-38. 5 refs.

Coal gasification, while providing a route to coal combustion which facilitates the removal of ash and sulfur, has two major disadvantages: it consumes large quantities of water, especially significant in arid western states where some of the largest coal reserves are located, and it is less efficient than direct combustion. Some reactors provide limited optimization of either process efficiency or water consumption. Performance optimization is both application- and site-specific, and the choice of a coal gasification system depends to a large extent on the requirements and locations of the end-use markets. In general, relatively small energy requirements appear to be best met by the Wellman-Galusha reactor system if water is not scarce, while Koppers-Totzek or Lurgi systems are preferable for large users. The pressure of the Lurgi system enhances the economics of combined-cycle electrical power production plants, and this system would be the preferred unit if methanation becomes the dominant mode. Koppers-Totzek units require less water than does the Lurgi system. C.K.D.

A76-36407 Preliminary small-scale combustion tests of coal liquids. J. E. Haebig, B. E. Davis, and E. R. Dzuña (Gulf Research and Development Co., Pittsburgh, Pa.). *Environmental Science and Technology*, vol. 10, Mar. 1976, p. 243-247. 10 refs.

Nonupgraded coal liquids contain high concentrations of nitrogen and aromatics. The tendency for such fuels to emit excessive amounts of NO_x/ and smoke was examined in burning tests in a modified 1-gph boiler equipped with an air-atomizing nozzle. Full-boiling range and distillate coal liquids were tested, and conventional nitrogen-doped petroleum fuel oils were used for comparison. At 80% excess air, the fraction of the fuel-bound nitrogen converted to NO_x/ was 80%, but the conversion decreased to 35% at 25% excess air. Petroleum oils exhibited similar behavior. The use of a set of modified burners showed that increasing the air-fuel mixing rate decreased the smoke emissions, but increased the conversion of fuel-bound nitrogen. (Author)

A76-36410 Fuel and feedstock from refuse. J. L. Kuester (Arizona State University, Tempe, Ariz.) and L. Lutes (Rice University, Houston, Tex.). *Environmental Science and Technology*, vol. 10, Apr. 1976, p. 339-344. 6 refs.

Pyrolysis processes for the conversion of municipal solid waste to usable materials are discussed. The relative advantages of shaft-vertical, shaft-horizontal, rotary kiln, and fluidized bed type

reactors are considered, together with the relationship of reactor type and heating method (direct or indirect) to the heating rate and complexity of operation. The feed conditions, product distribution, heating method, and reactor type of 24 pyrolysis projects completed or in progress are given. C.K.D.

A76-36415 Processing energy from wastes. E. M. Wilson (Ralph M. Parsons Co., Pasadena, Calif.) and H. M. Freeman (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, Ohio). *Environmental Science and Technology*, vol. 10, May 1976, p. 430-435.

Typical heating values from wastes range from 3000-10,000 Btu/lb, depending on water content. The residual energy in solid, liquid, and gaseous waste materials can be economically recovered from the original material or from a conversion product, depending on the relative amounts of wastes available and the fuel requirement of energy consumers in the region. Such waste-derived energy can potentially supply a significant portion of national energy needs. The status of current waste-as-fuel projects is summarized. C.K.D.

A76-36424 Flywheels - Energy-saving way to go. *Environmental Science and Technology*, vol. 10, July 1976, p. 636-639.

A variety of flywheel-based propulsion systems and energy-storage systems being designed and tested in rapid transit systems are described. Regenerative braking uses the energy otherwise lost in braking to charge the flywheel, with 20-30% savings in power and costs. Hybrid systems combining flywheels with internal combustion engines or lead-acid batteries are discussed. The strength and density of the flywheel material and the flywheel configuration are viewed as principal design variables, and new flywheel materials are considered: Kevlar fiber (used in automotive tires), steel wire, wood fiber, and filament winding. Energy saved via flywheels can be put to other uses (e.g., air conditioning) or chalked up to savings in power costs. R.D.V.

A76-36625 The evolution of energy problems (Evolution des problèmes énergétiques). M. Boiteux (Electricité de France, Paris, France). *Revue Française de l'Electricité*, vol. 49, 1st Quarter, 1976, p. 6-15. In French.

Different scenarios for the evolution of world energy consumption over three time intervals (present-1985; 1985-2000; 2000-2060) are discussed. It is concluded that the most likely rate of expansion will lead to a global consumption of 14 billion tons coal equivalent (tce) in 1985, 30 billion tce in 2000, and several hundreds of billions tce by 2060. In this scenario, the 'cooling' economies and declining birth rates of the industrialized nations will be counterbalanced by the expanding economies of developing nations, especially those of the oil producing countries. The year 2000 will signal the start of a leveling off of per capita energy consumption. The depletion of fossil fuel resources will be felt most sharply in Europe, which has few native reserves. The role of electricity in the European energy economy is examined in detail, taking into account the contributions of nuclear power plants and the potential advantages of using fossil fuels primarily for the generation of electricity. C.K.D.

A76-36587 Economic benefits of digital electronic propulsion controls for advanced commercial aircraft. G. J. Sevich and D. M. Newirth (United Technologies Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *Society of Automotive Engineers, Air Transportation Meeting*, New York, N.Y., May 18-20, 1976, Paper 760508. 9 p. 6 refs.

Economic advantages of digital electronic controls over their hydromechanical counterparts for commercial aircraft propulsion applications are discussed. The discussion covers control system comparison, engine maintenance, fuel consumption, control system maintenance cost, delay and cancellation data, and credibility of predictions. The cost studies predict significant benefits if digital controls replace conventional hydromechanical controls in advanced transport engines. As much as 50% improvement in hot section life can be anticipated due to more accurate thrust control. Fuel

consumption may be reduced by 1% due to increased control capability and reduction in trim requirements. Maintenance cost for the control system itself may be lowered as much as 50%. Delays and cancellations chargeable to the control system can be reduced by a factor of 3. However, the estimates must be assessed with caution since they are necessarily based on unsubstantiated reliability and cost predictions. S.D.

A76-36588 Air transport propulsion improvement opportunities with advanced controls. F. C. Gray (Douglas Aircraft Co., Long Beach, Calif.). *Society of Automotive Engineers, Air Transportation Meeting, New York, N.Y., May 18-20, 1976, Paper 760509*. 12 p. 5 refs. Research sponsored by the McDonnell Douglas Independent Research and Development Program.

A survey of twelve commercial airlines was conducted to evaluate the performance of current propulsion control systems (PCS) and to identify priority target areas for research and development. Eight airplane types, representing the three generations of gas-turbine-powered commercial transports put into service since 1958, were included in the study. Major problem areas in third generation subsonic transport PCS, in descending order of relative need for improvement, are the thrust command links, the auto-throttle system, the engine electrical-output sensors, and the thrust levers. Airline preferences with regard to different design alternatives to alleviate specific problems in these priority areas are analyzed, and general requirements for a PCS based on 1985 technology are developed. C.K.D.

A76-36603 * Fuel conservative propulsion concepts for future air transports. D. E. Gray and J. W. Witherspoon (United Technologies Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *Society of Automotive Engineers, Air Transportation Meeting, New York, N.Y., May 18-20, 1976, Paper 760535*. 11 p. 10 refs. NASA-sponsored research.

The results of a feasibility study of proposed fuel conservative propulsion concepts for air transports with an assumed Mach 0.8 cruise capability are summarized. All engines considered are based on projected 1985 technology. Operating fuel requirements, propulsion operating costs, and noise characteristics are compared with those of a present technology turbofan engine. The study indicates that an advanced Brayton cycle gas generator in a turbofan engine or geared to an advanced multibladed, small diameter propeller with a projected efficiency of 80% at Mach 0.8 offers the greatest potential for energy conservation. C.K.D.

A76-36604 Alternative concepts for advanced energy conservative transport engines. R. Hirschkron and R. E. Neitzel (General Electric Co., Fairfield, Conn.). *Society of Automotive Engineers, Air Transportation Meeting, New York, N.Y., May 18-20, 1976, Paper 760536*. 15 p.

The projected fuel consumption characteristics of three unconventional engine design concepts were compared with those of a conventional advanced direct drive turbofan for long range transports designed to cruise at a flight Mach number of 0.8. All engines considered were based on technology compatible with entry into service in the mid to late 1980s. Regeneration and other cycles involving heat exchangers did not offer fuel advantages over the conventional design due to size and weight considerations. Geared turbofans and turboprop engines based on projected improvements in propeller efficiency to the 80% range for Mach 0.8 high disk loading designs showed potential for significant improvements in specific fuel consumption. C.K.D.

A76-36605 Fuel conservative potential for the use of turboprop powerplants. R. L. Foss and J. P. Hopkins (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, Air Transportation Meeting, New York, N.Y., May 18-20, 1976, Paper 760537*. 15 p. 6 refs.

The turboprop propulsion system may offer the air transportation industry one of the most significant means of achieving reduced operating costs through large reductions in fuel consumption. The

prop-fan high speed propeller concept allows the superior propulsive efficiency exhibited by the turboprop to be extended to cruise speeds compatible with current turbofan aircraft. Comparison of a prop-fan and a turbofan powered aircraft, each designed on an equal technology, equal mission and equal comfort basis is used to illustrate the prop-fan benefits. Accountability for the differences in the installation requirements of each propulsion system is included. The significant fuel and cost improvements shown for the prop-fan aircraft call for an extensive research program to verify the performance of this propulsion concept and to provide a data base that will allow incorporation in future aircraft. (Author)

A76-36606 Aircraft propulsion - A key to fuel conservation: An aircraft manufacturer's view. J. A. Stern (Douglas Aircraft Co., Long Beach, Calif.). *Society of Automotive Engineers, Air Transportation Meeting, New York, N.Y., May 18-20, 1976, Paper 760538*. 18 p.

A range of possible approaches to fuel conservation is examined. The fuel contribution to direct operating costs, aircraft operations and maneuvers designed to conserve fuel, aircraft design variants, modifications, and refittings capable of aiding fuel conservation are discussed. Advantages of turbofan and turboprop derivatives of basic aircraft designs are examined. The RECAT (Reducing Energy Consumption of Commercial Air Transportation) program is outlined. The possible impact of recent technological advances in aircraft design (supercritical airfoils, optimized wing geometry, longitudinal stability augmentation, composites, new metallic structures) on fuel conservation is examined. R.D.V.

A76-36625 The evolution of energy problems (Evolution des problèmes énergétiques). M. Boiteux (Electricité de France, Paris, France). *Revue Française de l'Electricité*, vol. 49, 1st Quarter, 1976, p. 6-15. In French.

Different scenarios for the evolution of world energy consumption over three time intervals (present-1985; 1985-2000; 2000-2060) are discussed. It is concluded that the most likely rate of expansion will lead to a global consumption of 14 billion tons coal equivalent (tce) in 1985, 30 billion tce in 2000, and several hundreds of billions tce by 2060. In this scenario, the 'cooling' economies and declining birth rates of the industrialized nations will be counterbalanced by the expanding economies of developing nations, especially those of the oil producing countries. The year 2000 will signal the start of a leveling off of per capita energy consumption. The depletion of fossil fuel resources will be felt most sharply in Europe, which has few native reserves. The role of electricity in the European energy economy is examined in detail, taking into account the contributions of nuclear power plants and the potential advantages of using fossil fuels primarily for the generation of electricity. C.K.D.

A76-36626 Arc-Isère - Final energy link of the Maurienne (Arc-Isère - Ultime maillon énergétique de la Maurienne). G. Marin (Electricité de France, Chatou, Yvelines, France). *Revue Française de l'Electricité*, vol. 49, 1st Quarter, 1976, p. 34-41. In French.

The hydroelectric complex under construction in the Maurienne Valley utilizing the Arc-Isère river system is discussed. The project involves the construction of new storage reservoirs and the diversion of the Lesser Arc at Saint-Jean-de-Maurienne to join the Isère at Cheylas. The 60 km loop formed by these rivers will be cut by an underground conduit system about 30 km in length, which will feed an underground hydroelectric installation at Cheylas. Upon its completion in 1978, Arc-Isère is expected to provide an annual energy production of 3300 GWh. C.K.D.

A76-36638 Room heating with solar energy in the Federal Republic of Germany (Raumheizung mit Sonnenenergie in der Bundesrepublik Deutschland). G. Dietrich (Kraftanlagen AG, Heidelberg, West Germany). *Brennstoff-Wärme-Kraft*, vol. 28, Jan. 1976, p. 23-28. 21 refs. In German.

A survey is provided of the technical possibilities concerning the utilization of solar energy in West Germany. The available amount of solar energy is examined and a description is given of the various

types of solar collectors. Suitable locations for solar collectors are discussed along with questions regarding their installation and aspects of heating economy. Attention is given to the thermal balance for a one-family house, the heating of water, and a comparison of solar heating with conventional heating methods. Research activities related to solar heating applications are discussed and an estimate is given of the potential significance of solar heating in the year 2000. G.R.

A76-36726 Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Conference sponsored by the Government Institutes. Edited by T. F. P. Sullivan (Government Institutes, Inc., Washington, D.C.). Washington, D.C., Government Institutes, Inc., 1975. 352 p. \$25.

The development of coal technology and of petroleum, natural gas, and oil shale technology in the framework of ERDA is described. Nuclear technology as applied to energy production is considered, with discussions of Liquid Metal Fast Breeder Reactor Development and fusion power research and development. International energy technology is examined with reports on energy in Britain, Canada, Japan, Germany, France, the Netherlands, and Mexico. Also discussed are energy conservation and the environment, energy storage and transmission, and solar heating and cooling programs. Other topics of interest were magnetohydrodynamic energy technology, hydrogen-based energy, and geothermal energy. B.J.

A76-36727 Coal technology - Actions and plans. G. A. Mills (ERDA, Div. of Advanced Research and Supporting Technology, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 23-39.

The current status of the Coal Program of the Energy Research and Development Administration is reviewed with emphasis on objectives, strategy, organization, program implementation, and economics. The principle objectives of the Coal Program are: (1) coal gasification and liquefaction to produce fuel; (2) new methods of direct coal combustion; and (3) the development of advanced power conversion systems using coal. The advanced research and supporting technology of the Coal Program is discussed along with the state of the art of coal liquefaction and high and low BTU gasification. A variety of tables, listing production costs and detailing technology and materials considerations, are presented. B.J.

A76-36728 Petroleum, natural gas, and oil shale technology. H. N. Dunning (ERDA, Div. of Petroleum, Natural Gas, and In-Situ Technology, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 40-49.

One of the divisions of the Fossil Energy directorate of the Energy Research and Development Administration - the petroleum, natural gas, oil shale, and in situ coal gasification program - is described. The specific objectives of this program are to provide cost-sharing contracts for field demonstrations of known but unrefined technology of a size and in sufficient numbers to persuade industry to adapt them to the major oil and gas reservoirs. The program also includes strengthening of the in-house research at Energy Research Centers and an active contract program with universities to provide gap-filling data and new methods of oil recovery. B.J.

A76-36729 Reactor research and development. T. A. Nemzek (ERDA, Div. of Reactor Research and Development, Arlington, Va.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 50-57.

After a brief review of the energy situation and the development of nuclear power, the United States Breeder Reactor Program is discussed. The development of the Liquid Metal Fast Breeder

Reactor as an energy source in the United States (the Fast Flux Test Facility and the Clinch River Breeder Reactor) and abroad is considered. Certain environmental and safety issues - the management of radioactive wastes, toxic effects of plutonium, etc. - are touched upon. B.J.

A76-36730 Fusion power research and development. R. L. Hirsch (ERDA, Div. of Controlled Thermonuclear Research, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 58-80.

The controlled fusion program of the Energy Resources and Development Administration is reviewed. The production of electricity from fusion power plants is described along with the basis of fusion. Fusion research in the United States emphasizes three magnetic confinement techniques (Tokamak and theta pinch machines and the magnetic mirror machine) and laser-pellet fusion. Existing confinement experiments - ORMAK at Oak Ridge, the Adiabatic Toroidal Compressor at Princeton, the theta pinch program at Los Alamos and the magnetic mirror program at the Lawrence Livermore Laboratory - are discussed and photographs of some of the machines are presented. Future confinement experiments are considered, with emphasis on the Princeton Large Torus and the Tokamak Fusion Test Reactor. The principles of laser fusion are discussed. B.J.

A76-36731 Energy technology activities of the British government and industry. L. H. Leighton (Department of Energy, Energy Technology Div., London, England). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 81-98.

A76-36732 Canadian energy research and development. C. H. Smith (Department of Energy, Mines and Resources, Ottawa, Canada). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 99-104.

A76-36733 Sunshine project of the Japanese Government. S. Sakakura (Ministry of International Trade and Industry, Agency for Industrial Science and Technology, Tokyo, Japan). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 105-121.

The Sunshine Project of Japan was started in 1974, is planned to be completed by 2000, and has as its aim the development of the following energy sources: (1) solar energy, (2) geothermal energy, (3) coal gasification and liquefaction, and (4) hydrogen energy. The project, run by the Japanese Ministry of Trade and Industry, is to be promoted on a national scale with full cooperation from national research institute organizations, universities, and private enterprise, as well as through international cooperation. Tables are presented detailing the research and development aspects of the Sunshine Project, with such particularities as geothermal well drilling techniques and power generation using hot water and photovoltaic and thermionic power generation. B.J.

A76-36734 Energy Research and Development Program of the Federal Republic of Germany. H. J. Stöcker (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 122-126.

A76-36735 General orientation on French policy of research and development in the field of energy. J. Pheline. In: Energy technology II; Proceedings of the Second Conference, Washington,

D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 127-134.

A76-36736 Energy research and development program for the Netherlands. W. van Gool (Utrecht, Rijksuniversiteit, Utrecht, Netherlands). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 135-142.

A76-36737 Energy technology in Mexico. J. Eibenschutz (Comisión de Energéticos, Mexico). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 143-149.

A76-36738 Energy storage technology - A user's analysis. P. A. Petzrick (U.S. Navy, Energy and Natural Resources Research and Development Office, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 160-168. 6 refs.

An analysis of U.S. Navy energy demand was undertaken in order to determine the relevance of energy storage technology to the specific requirements of the Navy. The energy storage technologies considered were flywheel storage, pumped hydrostorage, compressed air storage, low-temperature thermal energy storage, and superconducting magnetic storage. The use of flywheel storage at the Naval Ship Research and Development Center at Carderock was considered together with energy storage at remote naval facilities and storage in transportation with emphasis on two aspects: more efficient generation of electricity and the use of regenerative braking.

B.J.

A76-36739 Solar demonstration activities. R. H. Fields (ERDA, Solar/Geothermal Div., Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 176-179.

The actions that the Energy Research and Development Administration intends to take to implement the Solar Heating and Cooling Buildings Demonstration Act passed by Congress are described. The objective of the program is to carry out demonstrations in such a manner as to prove the viability of using solar energy. The first action will be the Request for Information (RFI), the aim of which is to contact any company with solar energy technology, and to catalog the RFI responses. The second action will be the Program Opportunity Notice which requests companies to advise ERDA if they have integrated systems and are willing to put them in demonstration programs. Supporting research and development programs are discussed.

B.J.

A76-36740 Residential solar demonstration program. J. Sherman (U.S. Department of Housing and Urban Development, Div. of Energy, Building Technology and Standards, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 180-184.

A76-36741 EPRI - A year of progress. R. E. Balzhiser (Electric Power Research Institute, Palo Alto, Calif.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 185-192.

An overview is presented of some research and development projects under way in the Fossil Fuel and Advanced Systems Division of the Electric Power Research Institute (EPRI). These objects include: (1) the development of technologies for the environmentally compatible use of domestic fossil fuels in electric power production, including the production of clean fuels from and direct use of coal; (2) the improvement of the reliability and efficiency of energy

conversion systems; (3) the development of load levelling energy storage systems; and (4) the development of geothermal and solar energy and fusion as new energy sources for electric power production and alternate utility applications. The work of the other three divisions of EPRI - the Nuclear Power Division, the Transmission and Distribution Division, and the Energy Systems, Environment and Conservation Division - is also touched upon.

B.J.

A76-36742 Technological needs of the coal industry. J. P. Egan (National Coal Association, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 202-206.

Research and development within the coal industry is discussed in the framework of demands that will probably be placed on coal over the next decade. The magnitude of production growth, manpower, coal use in the utilities, the environmental problem, the conversion potential of coal and coal delivery are considered. The basic technological parameters of coal production in the next decade are examined and the following conclusions are drawn: (1) there must be major advances in extraction technology; (2) there must be equal attention to the development of qualified technical and engineering personnel; and (3) the various new technologies in the consumption and distribution areas must be brought to the commercial stage.

B.J.

A76-36743 Petroleum industry activities in energy research and development. A. L. Conn (Amoco Oil Co., Naperville, Ill.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 207-218.

The paper discusses the broader role of petroleum companies, not only in petroleum production, but in diverse fields of energy research and development. This broader program is divided into six areas: (1) fossil energy: oil and gas, tar sands, oil shale, coal gasification and liquefaction; (2) nuclear energy; (3) solar, geothermal and advanced energy systems; (4) environment and safety; (5) conservation; and (6) national security.

B.J.

A76-36744 Magnetohydrodynamic plan. W. D. Jackson (ERDA, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 219-233.

The work of the Electric Power Research Institute together with the Energy Research and Development Administration in developing MHD generators is reviewed. Current MHD technology is concentrated in the areas of testing MHD channels and the development of high temperature materials and designs for MHD system components. New electrode and channel designs have been produced together with coal slag as a protective coating for the channel walls. Plans for the construction of the Engineering Test Facility to be built in Montana for full MHD system tests are described. The current national MHD program, having as its objective the realization of commercial electric power generation using American high sulfur coal, is examined.

B.J.

A76-36745 Hydrogen-energy technology - Today and tomorrow. D. P. Gregory (Institute of Gas Technology, Chicago, Ill.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 234-241.

Basic factors concerning the attractiveness of hydrogen as an energy-delivery medium are related to certain assumptions regarding the production of hydrogen from water, the transportation of hydrogen as a fuel gas by long-distance pipelines, possibilities for storing hydrogen by the techniques used for natural gas storage, the delivery of hydrogen in existing gas distribution pipes, and the burning of hydrogen in existing gas-combustion equipment after minor device modifications. If these assumptions are valid, then hydrogen produced with the aid of nuclear or solar energy can

replace natural gas. Research conducted to develop the technology required for a use of hydrogen according to the considered assumptions is discussed along with questions of overall system efficiency. Attention is also given to the actions which would be needed to accelerate a proper evaluation of the hydrogen-energy option. G.R.

A76-36746 A Federal energy/environmental research and development program. S. J. Gage (U.S. Environmental Protection Agency, Office of Energy Research, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 242-270.

The Dixie Lee Ray Report released in December 1973 recommended a five-year \$10 billion energy research and development program to achieve national energy self-sufficiency. A supporting environmental effects program was also recommended. Developments following the release of the Ray Report are discussed, taking into account interagency task force reports, EPA's energy goals, the program planning structure, and components of the planning matrix. Attention is also given to approaches for implementing the program, an environmental control technology program, the environmental effects of energy use, details of the environmental program, aspects of program organization, and questions of interagency coordination. G.R.

A76-36747 Development of the nation's geothermal energy resources. P. Kruger (ERDA, Div. of Geothermal Energy, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 271-289. 10 refs.

Geothermal resources may be defined as localized deposits of geothermal heat concentrated at attainable depths, in adequate volumes, and at temperatures sufficient for commercial exploitation. The various types of geothermal resources are examined, taking into account the possibilities for their utilization as energy sources. It is pointed out that the utilization of geothermal energy varies with the quality of the available resources. A description of utilization technology is given and institutional aspects are discussed. Institutional problems are related to public acceptance, vested interests, historical precedents, existing regulations, overlapping jurisdictions, and economic and financial factors. G.R.

A76-36748 Federal solar research plans. L. O. Herwig (ERDA, Div. of Solar Energy, Washington, D.C.). In: Energy technology II; Proceedings of the Second Conference, Washington, D.C., May 12-14, 1975. Washington, D.C., Government Institutes, Inc., 1975, p. 315-332.

The federal funding history with respect to research on terrestrial applications of solar energy is briefly examined and the role of the Energy Research and Development Administration (ERDA) in the development of solar energy is considered. The solar energy technologies in ERDA's program are related to solar heating and cooling, solar thermal conversion, photovoltaic energy conversion, wind energy conversion, bioconversion, and ocean thermal conversion. It is expected that applications concerned with the heating and cooling of buildings, the utilization of wind energy, and an employment of biomass production could make a substantial contribution to the solution of the U.S. energy problems by the early 1980s. G.R.

A76-36796 Liquefaction of coal in hydrogen-donor and non-donor vehicles. R. C. Neavel (Exxon Research and Engineering Co., Baytown, Tex.). *Fuel*, vol. 55, July 1976, p. 237-242. 11 refs.

Coal liquefaction research was carried out to evaluate the physical aspects of the dissolution process, to evaluate the role of donor quality, and to assess the effect of oxidation of the coal on liquid yields. Coal, slurried with tetralin and heated rapidly to 4000 C, was converted to benzene-soluble liquid products through a reaction path which appears to involve thermal cleavage of chemical

bonds in the coal. Free radicals formed pyrolytically were stabilized in the early stages by autogenous hydrogen transfer and in later stages by abstraction of hydrogen from the hydrogen-donating tetralin. Reaction in nondonor vehicles (naphthalene, dodecane) resulted in dispersion, but repolymerization formed a benzene-insoluble material. Oxidation of the coal was deleterious to ultimate conversion. B.J.

A76-36798 The Thermos program of nuclear reactors which specialize in urban heating (Le programme Thermos de réacteurs nucléaires spécialisés dans le chauffage urbain). B. Lerouge (Société Technicatome, France). *Entropie*, vol. 12, no. 68, 1976, p. 22-28. In French.

The paper reviews the Thermos program, the idea of which is to supply low-pressure water at a temperature of 100 C from a low-output (about 100 MW), pool-type reactor. After a discussion of urban heating problems, the insertion of a reactor of this type into an urban heating network is considered. Environmental and safety problems associated with the utilization of nuclear-supplied heating are examined and the current state of the Thermos program is touched upon. B.J.

A76-36938 Plasma treatment of coal. T. W. Scott and M. Venugopalan (Western Illinois University, Macomb, Ill.). *Nature*, vol. 262, July 1, 1976, p. 48, 49.

The effectiveness of a low-temperature plasma treatment in converting coal to methane was investigated. A Siemens tube packed with bituminous coal (76.06% C, 5.48% H, 15.33% O, 1.05% N, 2.09% S) was excited at 68 W. The gaseous products pumping out of the plasma zone consisted primarily of H and CO, with small amounts of methane. The addition of 26 mm Hg of helium in runs longer than 1 hr increased the methane production. The addition of hydrogen to coal which had not been previously treated in a plasma led to greater methane production in runs less than 0.5 hr in duration. The electron spin resonance spectrum of the coal subjected to plasma showed a 2.5-fold increase in the spin concentration over an untreated sample, suggesting that a free radical mechanism may be involved in the gasification process. C.K.D.

A76-36973 The energy handbook /2nd revised and enlarged edition/ (Das Energiehandbuch /2nd revised and enlarged edition/). Edited by G. Bischoff (Köln, Universität, Cologne, West Germany) and W. Gocht (Berlin, Freie Universität, Berlin, West Germany). Braunschweig, Friedr. Vieweg und Sohn Verlagsgesellschaft mbH, 1976. 319 p. In German. \$41.90.

Questions concerning the occurrence, the deposits, and the reserves of energy carriers on earth are examined. The origin of organic energy carriers is discussed along with the mining, transportation, and use of lignite. The mining and processing of coal and its significance in the energy technology are described and the techniques for the extraction of oil and natural gas are considered. Attention is also given to uranium and thorium, water power resources, nuclear energy, natural and synthetic gas, and solar energy in its various forms. A description is presented of the world economy of primary energy carriers. Novel energy systems are considered for satisfying the energy requirements of the future. G.R.

A76-36976 # MHD electrical power generation - Prospects and issues. W. D. Jackson (ERDA, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 9th, San Diego, Calif., July 14-16, 1976, Paper 76-309*. 23 p. 25 refs.

Near-term (1985) and mid-term (1990) objectives which must be achieved to develop a commercial scale demonstration MHD electric power plant fueled by coal before 1990 are presented. The results of comparative economic analysis of the potential of several advanced power plants using coal and coal derived fuels are reviewed. Ten different advanced power plant concepts are compared parametrically, including open cycle, closed cycle, and liquid metal MHD. System engineering considerations for the development logic and design criteria are established in terms of systems - emphasizing open

cycle MHD - and components - combustor, generator, materials, seed recovery, emission control, magnets and power conversion systems. Planned MHD test facilities with a description of each during the three phases of development are reviewed. Program planning and key decisions based on national program strategy are described. MHD milestones leading to the national program, current development status and issues are highlighted. Key technology issues and prospects for MHD systems are reviewed. (Author)

A76-37085 Comparison of silicon solar cell efficiency for space and terrestrial use. E. S. Rittner and R. A. Arndt (COMSAT Laboratories, Clarksburg, Md.). *Journal of Applied Physics*, vol. 47, July 1976, p. 2999-3002. 5 refs. Research sponsored by the Communications Satellite Corp.

In an effort to compare the efficiencies of silicon solar cells for space and terrestrial use, measurements of short-circuit current, efficiency and incident solar power under air mass two conditions were carried out on variety of cells, including conventional satellite cells, violet cells and COMSAT nonreflective cells. It was shown that wavelength selective attenuation mechanisms - infrared absorption by water vapor and carbon dioxide and scattering by aerosols and water droplets - will produce a higher conversion efficiency for terrestrial use than for space use. However, the higher terrestrial efficiency implies only that the cell power output falls off more slowly than the solar power input as the sunlight is attenuated by transmission impairments. B.J.

A76-37091 * Theoretical analysis of Al_xGa_{1-x}As-GaAs graded band-gap solar cell. J. A. Hutchby (NASA, Langley Research Center, Hampton, Va.) and R. L. Fudurich (Computer Sciences Corp., Hampton, Va.). *Journal of Applied Physics*, vol. 47, July 1976, p. 3140-3151. 39 refs.

A practical theoretical analysis of an n/p graded band-gap Al_xGa_{1-x}As-GaAs solar cell indicates that the presence of a built-in electric field acting on holes in the surface layer increases the hole collection efficiency of a nearly optimum cell to a maximum of 97.8%. The electric field is created by the band-gap gradient and serves to reduce the surface hole recombination by 97% and reduce the bulk hole recombination by 80%, compared to a similar GaAs cell. These reduced losses increase cell response substantially for wavelengths less than 0.59 micron and yield a maximum air-mass-zero efficiency of 17.7% (not corrected for a 13% front-surface contact). The model includes an optimized antireflection coating, series resistance, and junction-recombination current. (Author)

A76-37092 * Theoretical optimization and parametric study of n-on-p Al_xGa_{1-x}As-GaAs graded band-gap solar cell. J. A. Hutchby (NASA, Langley Research Center, Hampton, Va.) and R. L. Fudurich (Computer Sciences Corp., Hampton, Va.). *Journal of Applied Physics*, vol. 47, July 1976, p. 3152-3158. 21 refs.

A comprehensive theoretical model of the graded band-gap Al_xGa_{1-x}As-GaAs solar cell is used to optimize the n-on-p cell. The model includes power losses due to surface, bulk, and junction minority-carrier recombination, series resistance, and photon reflection from an SiO antireflection coating of optimum thickness. The optimized cell has a junction depth/graded band-gap layer thickness of 1.0 micron, respective donor and acceptor concentrations of 4×10 to the 17th power and 2×10 to the 17th power per cu cm, and a surface AlAs mole fraction of $x = 0.35$. The optimized graded band-gap cell has an air-mass-zero efficiency of 17.7% (not corrected for a 13% front surface contact area) and is shown to be less sensitive than a similar n-on-p GaAs cell to material degradation in the form of decreased minority-carrier diffusion lengths and increased surface-recombination velocity. (Author)

A76-37093 Open-circuit voltage of MIS silicon solar cells. J. P. Ponpon (CNRS, Centre de Recherches Nucléaires de Strasbourg, Strasbourg, France) and P. Siffert (Strasbourg I, Université, Strasbourg, France). *Journal of Applied Physics*, vol. 47, July 1976, p. 3248-3251. 12 refs.

The open-circuit voltage of MIS solar cells realized on n-type silicon has been investigated. Chemically formed and evaporated SiO_x layers have been used for the insulating film. The latter has given the best results on polished samples, since the open-circuit voltage reached 0.55V. The influence of different parameters, such as the diode quality factor and barrier height, are discussed. (Author)

A76-37145 # Review of the state of the art of Tokamak development in the USSR (Obzor sovremennogo sostoiianiia rabot na Tokamakakh v SSSR). S. V. Mirnov, V. S. Mukhovatov, V. S. Strelkov, and V. D. Shafranov (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Fizika Plazmy*, vol. 2, Mar.-Apr. 1976, p. 348-360. 18 refs. In Russian.

Experimental results are presented concerning the Soviet Tokamaks T-4, TM-3, T-6 (2), T-9, Tuman-2, TO-1, FT-1, TM-IVCH, and PT-4 and relating to data on plasma disturbances, HF plasma heating at electron cyclotron resonance, anomalous resistance, adiabatic compression and the possibility of a Tokamak with a noncircular cross section. The review article also touches upon more modern Tokamaks, including the T-10, T-8, T-11, T-12, TO-2, TM-4, Tuman-3, TB-0 and T-20. B.J.

A76-37350 Fueling the future: An environmental and energy primer. R. T. Sheahan. New York, St. Martin's Press, Inc., 1976. 142 p. 30 refs. \$7.95.

The book provides a nontechnical description of the processes used to exploit different power sources: conventional fossil fuels, synthetic fossil fuels, present and proposed types of nuclear reactors, magnetohydrodynamics, hydropower, geothermal power, and solar and wind power. The most important sources of air and water pollution are identified, and the environmental impact of the different types of power plants is assessed. Special attention is given to the problem of salvaging energy from urban wastes. An appendix section outlines the responsibilities of the different governmental agencies concerned with protection of the environment and provides brief summaries of the major provisions of present environmental legislation. C.K.D.

A76-37461 # Shock tube for investigating high-temperature MHD generators (Udarnaia truba dlia issledovaniia vysokotemperaturnykh MGD-generatorov). A. D. Belykh, V. A. Gurashvili, V. S. Golubev, S. V. Pashkin, and A. A. Iakushev (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 14, Mar.-Apr. 1976, p. 353-358. 6 refs. In Russian.

The shock tube described was used as a plasma source for studying the physical phenomena in large-scale magnetohydrodynamic generators at thermal powers of up to 1 GW. The energy stored in the driving gas reached 10 mJ at pressures of 500 atm abs. Some results obtained at gas temperatures up to 15,000 K are examined. V.P.

A76-37660 Time-varying energy consumption as a factor in urban climate. K. E. Torrance and J. S. W. Shum (Cornell University, Ithaca, N.Y.). *Atmospheric Environment*, vol. 10, no. 4, 1976, p. 329-337. 32 refs. Research supported by the National Center for Atmospheric Research and Cornell University; NSF Grant No. GI-29903.

The thermal effects of urban energy consumption are investigated using a time-dependent, one-dimensional, numerical model. The surface energy balance includes a time-varying rate of anthropogenic heat addition from transportation, electric consumption, and space heating sources. Industrial input is treated as a constant. The contribution of each source to the urban temperature is determined for typical winter and typical summer days. Results indicate that transportation and electric usage accentuate the afternoon heat island and moderate the nocturnal heat island. Space heating in winter enhances the nocturnal heat island. Comparison of urban and rural simulations reveals two distinct types of urban heat islands, controlled by the combined effects of heat addition, moisture, and roughness. The moderating influence of increasing wind speed is also examined. (Author)

A76-37692 # Performance comparison between flat-plate and moderately concentrating solar energy collectors. J. R. Howell, R. B. Bannerot (Houston, University, Houston, Tex.), D. G. Elliot, and J. Reber (Hudson Engineering Corp., Houston, Tex.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 11th, San Diego, Calif., July 14-16, 1976, Paper 76-447.* 6 p.

Moderate concentration (up to three-to-one) of solar energy can be obtained using a trapezoidal groove configuration with some type of absorbing surface at the base. A comparison of this type of collector with a conventional flat-plate collector is being made on a large scale in Houston, Texas. A 1200 square foot array made up of 80 percent flat-plate and 20 percent trapezoidal groove collectors provides energy to a heat pump that heats a 50,000 square foot office building. Instantaneous and daily performance of each collector type has been monitored and is reported here. (Author)

A76-37693 # Performance predictions of a water-cooled solar absorption air-conditioning system using a stochastic weather model. D. K. Anand, R. W. Allen, and E. O. Bazques (Maryland, University, College Park, Md.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 11th, San Diego, Calif., July 14-16, 1976, Paper 76-448.* 10 p. 8 refs. Contract No. E(40-1)-4976.

The performance of a solar powered water-cooled absorption air-conditioning system is obtained using real and synthetic data. The synthetic data is derived using five years of weather history and represented by a joint probability density matrix and six constants. The system performance is obtained as a function of dry-bulb temperature, wet-bulb temperature, and solar insolation. The coefficient of performance using real data and synthetic data is compared and the predictions based on synthetic data are quite good. It is concluded that synthetic data allow very inexpensive simulation and yield satisfactory results for design purposes. (Author)

A76-37695 # A review of natural convection phenomena in solar collectors. L. W. Spradley (Lockheed Missiles and Space Co., Inc., Huntsville, Ala.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 11th, San Diego, Calif., July 14-16, 1976, Paper 76-450.* 9 p. 35 refs.

A review is given of the natural convection phenomena which occurs in the air space between the absorber plate and cover of typical flat plate solar collector units. The review is intended to summarize the current knowledge of this problem. The types and modes of flow which can occur and the parameters governing these flows are defined. The literature on analytical and experimental determination of resultant heat losses are reviewed and the various devices for suppressing or reducing the losses are then summarized. Conclusions reached by investigators are brought together as well as recommendations for further work in this problem area. (Author)

A76-37792 A high-efficiency power cycle in which hydrogen is compressed by absorption in metal hydrides. J. R. Powell, F. J. Salzano, W.-S. Yu, and J. S. Milau (Brookhaven National Laboratory, Upton, N.Y.). *Science*, vol. 193, July 23, 1976, p. 314-317. ERDA-sponsored research.

A high-efficiency power cycle is proposed in which molecular hydrogen gas is used as a working fluid in a regenerative closed Brayton cycle. The hydrogen gas is compressed by an absorption-desorption cycle on metal hydride (FeTiHx) beds. Low-temperature solar or geothermal heat (temperature about 100 C) is used for the compression process, and high-temperature fossil fuel or nuclear heat (temperature about 700 C) supplies the expansion work in the turbine. Typically, about 90 percent of the high-temperature heat input is converted to electricity, while about 3 kilowatts of low-temperature heat is required per kilowatt of electrical output.

(Author)

A76-37840 Solar energy and space law (Sonnenenergie und Weltraumrecht). S. Gorove (Mississippi, University, University, Miss.). *Zeitschrift für Luft- und Weltraumrecht*, vol. 25, June 1976, p. 89-93. 25 refs. In German. (Translation).

The legal aspects of a utilization of solar energy are discussed, taking into account technological approaches involving the use of space stations. Approaches including the employment of a Satellite Solar Power Station (SSPS) in a synchronous orbit have been

considered to overcome a number of difficulties otherwise connected with the transformation of solar energy into electric energy on an economically competitive basis. Space law regulations concerning the activities of man in space are examined with respect to the relation of these regulations to the operation of the SSPS. It is concluded that the existing treaties will, possibly, have to be supplemented with additional international agreements as soon as the technological problems regarding the economic production of electric power on the basis of a utilization of solar energy have been solved. G.R.

A76-37851 Symposium on Energy Recovery from Solid Wastes, University of Maryland, College Park, Md., March 13, 14, 1975, Proceedings. Symposium sponsored by the Washington Academy of Sciences, American Chemical Society, National Center for Resource Recovery and American Society for Testing and Materials. *Resource Recovery and Conservation*, vol. 1, Apr. 1976. 125 p.

The papers comprising the Symposium review the state of the art and practice of energy recovery from the organic portion of wastes. Emphasis is on processing wastes to yield energy storage materials, ranging from solid fuel substitutes for coal to gaseous mixtures for fuel to proteins and chemical products. The topics include: the markets for and economics of heat energy produced from solid waste incineration; a feasibility study for burning refuse-derived fuel in the District of Columbia; an evaluation of methane production from solid waste; and the design and pollution control features of a steam generating refuse-energy plant in Saugus, Mass.

C.K.D.

A76-37852 The markets for and the economics of heat energy from solid waste incineration. M. J. Wilson and D. W. Swindle, Jr. (I.C. Thomasson and Associates, Inc., Nashville, Tenn.). (*Symposium on Energy Recovery from Solid Wastes, College Park, Md., Mar. 13, 14, 1975.*) *Resource Recovery and Conservation*, vol. 1, Apr. 1976, p. 197-206.

This study reviews the disposal and composition of solid waste with respect to its material and energy resources. It evaluates the economics of front-end materials resource recovery and the fluctuating markets for specific components, the energy extraction by conventional incineration, and steam production not only for process needs but also for coolant and/or heating. It touches briefly on energy recovery in the form of off-gas and liquids from pyrolyzers, shredding to provide 'fluff', and pelletizing. (Author)

A76-37853 Energy and resource recovery from solid wastes. G. M. Mallan and E. I. Titlow (Occidental Research Corp., La Verne, Calif.). (*Symposium on Energy Recovery from Solid Wastes, College Park, Md., Mar. 13, 14, 1975.*) *Resource Recovery and Conservation*, vol. 1, Apr. 1976, p. 207-216. 6 refs.

A process for the recovery of oil and other resources from municipal refuse has been developed by the Occidental Research Corporation with the objective of producing materials with a high market value. Magnetic separation of ferrous metals is carried out following the shredding of raw refuse to yield pieces smaller than 7.6 cm. Most inorganic material is then removed by air classification. The shredded refuse is dried to a 3% moisture content and screened to reduce the content of free inorganic material to less than 4% by weight. Glass is recovered by froth flotation, and aluminum is removed by a dry separation process using linear induction motors. A secondary shredding reduces the organic fraction to pieces smaller than 1.168 mm, and the resulting product is pyrolyzed under strict pollution control conditions to yield oil and combustible gases. A 1360 metric ton/day facility using this procedure is scheduled for construction in Bridgeport, Conn.

C.K.D.

A76-37854 Feasibility study for burning refuse-derived fuel in the District of Columbia by Potomac Electric Power Company. B. V. Viscomi (Lafayette College, Easton, Pa.). (*Symposium on Energy Recovery from Solid Wastes, College Park, Md., Mar. 13, 14, 1975.*) *Resource Recovery and Conservation*, vol. 1, Apr. 1976, p. 217-224.

A76-37855 Union Electric Company's Solid Waste Utilization System. D. Klumb (Union Electric Co., St. Louis, Mo.). (*Symposium on Energy Recovery from Solid Wastes, College Park, Md., Mar. 13, 14, 1975.*) *Resource Recovery and Conservation*, vol. 1, Apr. 1976, p. 225-233.

A Solid Waste Utilization System capable of processing 7300 metric tons of solid refuse from the St. Louis metropolitan area per day is under construction and scheduled for full operation in June 1977. Solid wastes collected at transfer stations will be transported to a 5500 ton/day processing facility associated with the 2400 MW Labadie power plant and to a 1800 ton/day facility associated with the 900 MW Meramec power plant. Following removal of magnetic metals and about half of the glass and grit content, the shredded wastes will be air-classified into burnable and unburnable fractions. The combustible fractions will be stored in bins and supplied by a rotary air feeders to solid waste burners providing supplementary heating to pulverized coal-fired boilers. C.K.D.

A76-37856 Design and pollution control features of the Saugus, Massachusetts steam generating refuse-energy plant. W. K. Macadam (Wheelabrator-Frye, Inc., New York, N.Y.). (*Symposium on Energy Recovery from Solid Wastes, College Park, Md., Mar. 13, 14, 1975.*) *Resource Recovery and Conservation*, vol. 1, Apr. 1976, p. 235-243, 7 refs.

A steam generating plant which will consume 1089 metric tons of solid refuse per day is nearing completion at Saugus, Mass. The system is an application of the Von Roll type water tube cooled boiler system with stepped gates, firing refuse essentially as received without the use of supplementary fuel. Peak delivery will be 159 metric tons of steam per hour. Clean metals and sterile ash for road fill will be recovered initially. Fly ash and particulates in the flue gas will be reduced to levels well below those specified by environmental regulations by means of collection hoppers under the boiler convection sections, followed by Wheelabrator-Lurgi electrostatic precipitators. No special measures to remove sulfur will be taken, since refuse typically was a low (0.1%) sulfur content. The exit gases, consisting primarily of nitrogen, carbon dioxide, and water vapor, will be dispersed by a 54 m stack. Flame temperatures will be maintained below the level at which significant production of nitrogen oxides occurs. C.K.D.

A76-37857 An evaluation of methane production from solid waste. R. G. Kispert, S. E. Sadek, and D. L. Wise (Dynatech R/D Co., Cambridge, Mass.). (*Symposium on Energy Recovery from Solid Wastes, College Park, Md., Mar. 13, 14, 1975.*) *Resource Recovery and Conservation*, vol. 1, Apr. 1976, p. 245-255, 22 refs. NSF Grant No. C-827.

A technical and economic evaluation of a process to convert municipal solid waste to a pipeline quality gas has been carried out, based upon a previously reported conceptual design for a 907 metric ton/day (1000 tpd) facility. The process design is shown to be technically within the state of the art, although economically acceptable operating parameters are at the upper limit of today's technology. The calculated baseline gas cost of \$0.074 per cu m (\$2.09/mcf) is economically acceptable when compared with projected costs of synthetic gas or alternative fuels. Experimental priorities to demonstrate the commercial feasibility of the process are established. (Author)

A76-37858 Energy from refuse by bioconversion, fermentation and residue disposal processes. J. T. Pfeffer and J. C. Liebman (Illinois, University, Urbana, Ill.). (*Symposium on Energy Recovery from Solid Wastes, College Park, Md., Mar. 13, 14, 1975.*) *Resource Recovery and Conservation*, vol. 1, Apr. 1976, p. 295-313, 7 refs. NSF Grant No. G1-39191.

To determine the feasibility of the conversion of municipal refuse to methane by means of an anaerobic fermentation process, laboratory studies were conducted to evaluate the quantity and rate of gas production, reactor slurry dewatering characteristics, and

residue disposal options. The experimental data were used in a computer analysis to determine the effects of different operating parameters and systems designs on the overall process efficiency. Results indicate that it is possible to recover methane alone with an overall energy recovery efficiency of 32.6%; efficiency is increased to 63.4% if the steam generated by incineration of the spent cake can be marketed. C.K.D.

A76-37861 The economics of recovery of materials from industrial waste - A case study. A. V. Bridgwater (Aston, University, Birmingham, England). *Resource Recovery and Conservation*, vol. 1, Oct. 1975, p. 115-127, 13 refs.

Millions of pounds worth of valuable materials are discarded every year in industrial wastes because contamination, dilution, or the scale of recycling operations makes recovery uneconomical. The problems and possibilities of recovering valuable materials from liquid and liquid-solid industrial wastes are outlined by reference to evaluations made in several case studies. An examination is made of wastes removed by a West Midlands disposal contractor over a twelve month period. The ways in which these wastes are dealt with at present by surface and subsurface disposal are discussed along with the hazards and safety factors inherent in such operations. In the wastes disposed of, the most potentially valuable materials to recover were hydrochloric acid and zinc. The relationship between recovery and dumping is discussed and future trends suggested. It is recommended that recovery of more materials should be undertaken, perhaps as a governmental service, and that the advantages of economy of scale be utilized by combining wastes from several sources. (Author)

A76-37864 Current trends in municipal solid waste disposal in New York City. R. Fenton (New York City, Environmental Protection Administration, New York, N.Y.). *Resource Recovery and Conservation*, vol. 1, Oct. 1975, p. 167-176, 18 refs.

A76-37865 Evaluation of the efficiency of energy resource recovery systems. R. C. Bailie and D. M. Doner (West Virginia University, Morgantown, W. Va.). *Resource Recovery and Conservation*, vol. 1, Oct. 1975, p. 177-187, 7 refs.

The energy recovery potential of a resource recovery system is often represented by a single numerical value described as an energy efficiency. This paper details how various numerical values of efficiency can be provided for the same conversion process. To overcome such ambiguity, and to provide a method for comparing systems, a systematic method for evaluating the efficiency of recovery processes is developed which provides a single value for each conversion process. The method is applicable only as long as the conversion processes being compared produce the same energy products. (Author)

A76-37866 Evaluation of energy substitution equivalent. R. C. Bailie and D. M. Doner (West Virginia University, Morgantown, W. Va.). *Resource Recovery and Conservation*, vol. 1, Oct. 1975, p. 188-191, 6 refs. Research supported by the National Center for Resource Recovery and NSF.

Alter (1975) has suggested that a substitution energy equivalence be used rather than an arithmetic energy equivalence as the basis for policy decisions involving energy conversion systems. In this paper substitution equivalence is defined as the amount of fossil fuel that would be saved if the fossil fuel generating system used to produce an energy product were replaced by an energy resource recovery system that produced essentially the same energy product. The concept is applied in two examples: the use of waste to produce methanol and the use of waste to produce steam in substitution for natural gas or coal. It is suggested that the substitution equivalent for coal be used as a reference, since its conversion efficiencies are well known and since it is likely to be the most plentiful fossil fuel in the future. C.K.D.

A76-37996 # Deep chemical heat regeneration in MHD generator cycles (*Glubokaia khimicheskaia regeneratsiia tepla v tsiklakh MGD-generatora*). V. G. Nosach and V. T. Rogovoi (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 31, 1976, p. 53-57. 6 refs. In Russian.

The paper describes the thermal design of an MHD generator which reuses, through a chemical regeneration process, the heat of natural-gas combustion products. The dependence of combustion product enthalpy at the MHD channel outlet and of the heat utilization coefficients on the oxygen content in the working air is studied at temperatures from 1300 to 1700 K at the combustion chamber inlet. The possibility of efficient MHD cycles which would not use the steam cycle is discussed. The steam cycle would be used to compensate for the heat loss of the MHD generator. B.J.

A76-37998 # Feasibility of using atomic energy at existing thermal power plants (*O tselesoobraznosti ispol'zovaniia atomnoi energii na sushchestvuiushchikh teplovykh elektrostantsiakh*). V. G. Nosach and V. T. Rogovoi (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 31, 1976, p. 76-78. In Russian.

The paper describes the thermal design for the combined utilization of nuclear and organic fuels at existing electric power plants. The thermal design is analyzed on the basis of equations of material and thermal balance. Results show that the use of nuclear energy at thermal power plants is an efficient process which would obtain 50% of the heat for electric power generation from the nuclear fuel and would cut the consumption of organic fuel almost in half. B.J.

A76-38099 Possibilities to obtain energy from space (*Welche Möglichkeiten bieten sich bei der Energiegewinnung aus dem Weltraum an*). B. V. Kit (Maryland, University, College Park, Md.). *Astronautik*, vol. 13, May-June 1976, p. 40, 41. In German.

One of two critical problems of contemporary civilization is related to environmental pollution in connection with the waste products of human technology. The second problem is connected with the exhaustion of the available fossil-fuel resources. A suitable substitution of fossil fuel by another energy source could also solve the pollution problem which is essentially caused by the substances obtained as a result of fossil-fuel utilization. So far intensive and costly efforts to develop approaches for an employment of thermo-nuclear energy for peaceful applications have not been successful. The possibilities are, therefore, considered to use solar energy to satisfy the energy requirements of human society. A description is given of the various approaches which can be employed to transform solar energy into a form that is suitable for such a use. G.R.

A76-38221 * # A proposed concept for the extraction of energy stored in magnetic or electric fields in space. D. D. Papailiou (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 12th, Palo Alto, Calif., July 26-29, 1976, AIAA Paper 76-707*. 5 p. 8 refs. Contract No. NAS7-100.

It is known that enormous energy resources associated with electric, magnetic, gravitational, and other fields exist in space. It is also known that the major difficulty in 'tapping' this energy arises from the extremely low density level at which this energy exists. An analytical study has been made of a particular scheme that appears promising for an efficient utilization of some of these energy resources in propulsion. The principle involves the exchange of energy between a fluctuating magnetic field and a velocity field of electrically conducting fluid in turbulent motion located onboard a spacecraft. Under certain conditions the total energy of the turbulent

flow field onboard the spacecraft can be increased and this increase appears in the form of Joulean heat. The utilization of the fluctuating part of the magnetic field, in the form of Joulean dissipation (because of its random character) does not introduce any drag on the spacecraft. The application appears promising for flights in the vicinity of Jupiter and other planets. The rate at which energy is gained by the conducting fluid is of the order of 100 watts when the rms value of the fluctuating magnetic field strength is about 1 gauss. (Author)

A76-38260 # Comparisons of alternate energy efficient engines for future subsonic transports as affected by engine technology improvements. R. E. Neitzel (General Electric Co., Aircraft Engine Group, Lynn, Mass.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 12th, Palo Alto, Calif., July 26-29, 1976, AIAA Paper 76-770*. 11 p. 6 refs.

The major contenders for engines to power future subsonic transports include the conventional high bypass turbofan, the geared turbofan of somewhat higher bypass ratio, and the high disc loading turboprop. Typical designs involving projected advancements in technology are described and compared to a current turbofan. The key technology features for each of the advanced engines are identified and their relative importance in achieving an improvement in fuel usage and aircraft economics indicated. Goals for technology development are suggested on the basis that a new engine must provide a significant advantage in both aircraft economics and fuel usage. (Author)

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evaluated in a 60 degree sector combustor rig. Carboning and flashback characteristics at simulated takeoff conditions were evaluated in a 12 degree sector combustor rig. For the five fuels tested, effects were moderate, but well defined. Author

STAR ENTRIES

N76-22174# Committee on Interstate and Foreign Commerce (U. S. House).

INTERNATIONAL AIR TRANSPORTATION COMPETITION
Washington GPO 1974 456 p refs Hearings on H.R. 14266, H.R. 13824, H.R. 14355, H.R. 14394, H.R. 14627, H.R. 14970, and H.Res. 1405 before Comm. on Interstate and Foreign Commerce and the Subcomm. on Transportation and Aeron., 93d Congr., 2d Sess., 25-26 Jun., 10-11 Jul., and 9 Oct. 1974

(GPO-37-626) Avail: Comm. on Interstate and Foreign Commerce

Amendments to the Federal Aviation Act which deal with discriminatory and unfair practices in international air transportation and provide financial assistance during the energy crisis to U.S. air carriers engaged in overseas and foreign air transportation are discussed. Alternatives to a fuel subsidy are considered. These include: positive revenue impact of a fare increase; potential downward effect on fuel prices of a proposed Federal Energy Office rule requiring increased refining of jet fuel and its price-controlled allocation to the international airlines; possible consolidation of North Atlantic service by Pan Am and TWA; and granting of new route authority by the CAB. J.M.S.

N76-22197*# Pratt and Whitney Aircraft, East Hartford, Conn.
STUDY OF TURBOFAN ENGINES DESIGNED FOR LOW ENERGY CONSUMPTION Final Report

D. E. Gray Apr. 1976 119 p refs

(Contract NAS3-19132)

(NASA-CR-135002; PWA-5318) Avail: NTIS HC \$5.50 CSDL 21E

The near-term technology improvements which can reduce the fuel consumed in the JT9D, JT8D, and JT3D turbofans in commercial fleet operation through the 1980's are identified. Projected technology advances are identified and evaluated for new turbofans to be developed after 1985. Programs are recommended for developing the necessary technology. Author

N76-22398*# General Electric Co., Evendale, Ohio.
EXPERIMENTAL CLEAN COMBUSTOR PROGRAM, ALTERNATE FUELS ADDENDUM, PHASE 2 Final Report

C. C. Gleason and D. W. Bahr Jan. 1976 67 p refs

(Contract NAS3-18551)

(NASA-CR-134972; R76AEG268) Avail: NTIS HC \$4.50 CSDL 21D

The characteristics of current and advanced low-emissions combustors when operated with special test fuels simulating broader range combustion properties of petroleum or coal derived fuels were studied. Five fuels were evaluated; conventional JP-5, conventional No. 2 Diesel, two different blends of Jet A and commercial aromatic mixtures - zylene bottoms and naphthalene charge stock, and a fuel derived from shale oil crude which was refined to Jet A specifications. Three CF6-50 engine size combustor types were evaluated; the standard production combustor, a radial/axial staged combustor, and a double annular combustor. Performance and pollutant emissions characteristics at idle and simulated takeoff conditions were evaluated in a full annular combustor rig. Altitude relight characteristics were

N76-22403# Exxon Research and Engineering Co., Linden, N.J. Government Research Lab.

EVALUATION OF METHODS TO PRODUCE AVIATION TURBINE FUELS FROM SYNTHETIC CRUDE OILS, PHASE 1 Final Report, 24 Jun. 1974 - 24 Jan. 1975

Henry Shaw, Charles D. Kalfadelis, and Charles E. Jahnig Mar. 1975 284 p refs

(Contract F33615-74-C-2036; AF Proj. 3048)

(AD-A016456; GRU-1PEA-75; AFAPL-TR-75-10) Avail: NTIS CSDL 07/1

The feasibility of producing aviation turbine fuels from domestic coal and shale derived oils was assessed. Based on petroleum refining technology, the best methods currently available from making fuel products were evaluated for use in producing jet fuels from synthetics. It was concluded that shale oil is most likely to be used in jet fuel manufacturing. Coal liquids, on the other hand, will probably be used to make components for jet fuels and possibly also for new high density jet fuels. As a result of this analysis, it was recommended that shale oil hydroprocessing be emphasized in the experimental phase (Phase II) for producing specification aviation turbine fuels, along with the recommendation that hydroprocessing of coal oil should be studied as a source of jet fuel components and possibly as a new high density jet fuel. GRA

N76-22549# Committee on Interior and Insular Affairs (U. S. Senate).

AUTOMOTIVE RESEARCH AND DEVELOPMENT

Washington GPO 1975 108 p refs Hearing before Subcomm. on Energy Res. and Water Resources of Comm. on Interior and Insular Affairs, 94th Congr., 1st Sess., 5 May 1975

(GPO-56-712) Avail: Subcomm. on Energy Res. and Water Resources

Programs are discussed which can meet the national energy and automobile fuel economy goals, commensurate with clean air and economic growth objectives, and that are based on market-oriented alternatives. Author

N76-22632# Committee on Interstate and Foreign Commerce (U. S. House).

NATURAL GAS SUPPLIES, VOLUME 1, PART 1

Washington GPO 1975 816 p refs Hearings before Subcomm. on Oversight and Investigations of Comm. on Interstate and Foreign Commerce, 94th Congr., 1st Sess., 9, 13, 26-27 Jun.; 14, 21 Jul. 1975

Avail: NTIS Avail: Subcomm. on Oversight and Investigations

The accuracy of data supplied to the Federal Trade Association by the American Gas Association is considered. The possibility of underestimation of reserves and the formulation of cost of a wellhead are examined along with management decisions which might have adversely affected natural gas supplies. J.M.S.

N76-22633# Committee on Interstate and Foreign Commerce (U. S. House).

NATURAL GAS SUPPLIES, VOLUME 1, PART 2

Washington GPO 1975 986 p refs Hearings before Subcomm. on Oversight and Investigations of Comm. on Interstate and Foreign Commerce, 94th Congr., 1st Sess., 9, 13, 26-27 Jun.; 14, 21 Jul. 1975

(GPO-55-817) Avail: Subcomm. on Oversight and Investigations

For abstract, see N76-22632.

N76-22650# Research Triangle Inst., Research Triangle Park, N.C.

RANN UTILIZATION EXPERIENCE. CAST STUDY NO. 12:

OUTER CONTINENTAL SHELF OIL AND GAS

D. E. Kash and I. L. White 1975 33 p Prepared in cooperation with Oklahoma Univ., Norman
(Contract NSF C-927)

(PB-247256/1; NSF/RA/G-75-040) Avail: NTIS HC \$4.00
Also included in complete report and summary PB-247243, HC \$13.00 CSCL 081

This University of Oklahoma study of outer continental shelf (OCS) oil and gas operations was, at the time of its completion, the only comprehensive and disinterested study of both OCS oil and gas extraction technologies and government regulatory and management policies relating to those operations. The final report includes specific policy recommendations that were incorporated almost verbatim into several pieces of proposed federal legislation. The study has also accounted for the reshaping of several current policies and procedures of the agencies that control OCS leasing and management. This report briefly discusses the study and utilization of its results. GRA

N76-22651# Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Economics.

ATLANTIC OUTER CONTINENTAL SHELF ENERGY RESOURCES: ECONOMIC IMPLICATIONS FOR LONG ISLAND

Robert J. Kalter and Wallace E. Tyner Apr. 1975 84 p refs
Sponsored by NOAA

(PB-246963/3; NOAA-75102404) Avail: NTIS HC \$5.00 CSCL 05C

The following topics are discussed: the Atlantic outer continental shelf and its geology, potential reserves, production costs; and leasing possibilities; economic and social impacts; and effects of information constraints. Author

N76-22654# American Society of Civil Engineers, New York. **PROCEEDINGS OF THE CONFERENCE ON INTERDISCIPLINARY ANALYSIS OF WATER RESOURCE SYSTEMS**

J. Ernest Flack 1975 421 p refs Conf. held at Boulder, Colo., 19-22 Jun. 1973

(Contract DI-14-31-0001-3757)

(PB-248596/9; W76-03005; OWRT-X-126(3757)(1)) Avail: NTIS HC \$11.00 CSCL 13B

The Water Resources Systems Committee of the American Society of Civil Engineers; Technical Council on Water Resources Planning and Management saw a critical need for developing an interdisciplinary approach to water resources development. Formal papers on six interdisciplinary efforts were selected as case studies, around which discussions were built. These six papers include interdisciplinary studies on: (1) large reservoirs in Africa; (2) limnological modeling of the Great Lakes; (3) geothermal development; (4) the North Atlantic Regional Water Resources Study; (5) Corps of engineers planning experience in the St. Louis-Maine Creek; and (6) University research in the Wisconsin River and the Lower Fraser River (Brit. Columbia) water quality studies. Discussions are given after each paper. Included also is an introductory article on the interdisciplinary aspects of water resources planning and management. GRA

N76-22656 California Univ., Irvine.

OPTIMIZATION OF US ENERGY POLICY: OBJECTIVES AND ALTERNATIVES Ph.D. Thesis

Timothy Jordanides 1975 149 p

Avail: Univ. Microfilms Order No. 76-7234

A nonlinear dynamic model for petroleum utilization in the United States is developed. The structural formulation of the model is based upon the system dynamics approach taking into account both economic and geologic considerations. The emphasis is placed on portraying the nonlinear, feedback, and time lag character of energy usage. The final model is in state-variable form as a system of simultaneous, nonlinear, dynamic, discrete-time, difference equations. There are six state variables: domestic supply; inventory; capital investment for the production, exploration and refining of petroleum; capital investment for research and development of new sources of energy; substitution fraction; and domestic supply rate. There are two exogenous

inputs: population and import supply rate. The need for realistic control (policy) variables is shown in contrast to the predominance of price in previous energy models. Dissert. Abstr.

N76-22657* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

SOLAR ENERGY ABSORBER Patent

Lott W. Brantley, Jr., inventor (to NASA) Issued 20 Apr. 1976 6 p Filed 29 Oct. 1974 Supersedes N75-10585 (13 - 01, p 0076)

(NASA-Case-MFS-22743-1; US-Patent-3,951,129;

US-Patent-Appl-SN-518684; US-Patent-Class-126-271) Avail: US Patent Office CSCL 10A

A solar energy absorber is described; which includes a tubular absorber surface through which a fluid passes for transferring thermal energy from the absorber to other devices. Positioned above the tubular absorber surface are spaced glass layers. Positioned between an upper layer and the next layer is a vacuum, or air for minimizing thermal energy losses through convection. A clear liquid passes between two intermediate layers of glass for transferring the thermal energy absorbed by either the initial passage of the visible spectrum of electromagnetic rays or by infrared radiation from an absorber positioned below.

Official Gazette of the U.S. Patent Office

N76-22658 Syracuse Univ., N.Y.

HETEROJUNCTION SOLAR CELLS Ph.D. Thesis

Stephen Wai-Yan Lai 1975 155 p

Avail: Univ. Microfilms Order No. 76-7661

Two new types of heterojunction cells have been investigated for photovoltaic conversion. Each type consists of a Si substrate and a window layer which serves the triple purpose of being a transparent contact, providing an antireflection coating, and forming the junction barrier in the Si. Each type of cell was fabricated using low temperature processing. It is concluded that the concept of a heterojunction solar cell using a transparent semiconductor as window is valid. The limitation on efficiency of these heterojunction cells is primarily due to the substrate minority carrier band edge discontinuity at the interface.

Dissert. Abstr.

N76-22659 Oklahoma Univ., Norman.

ECONOMIC OPTIMIZATION MODELS OF WIND POWER SYSTEMS Ph.D. Thesis

Hee Man Bae 1975 193 p

Avail: Univ. Microfilms Order No. 76-8321

Models for the economic optimum design of large scale windpower systems were developed including systems without storage and systems with storage. The objective of the models is to maximize the total net value of electricity generated under assumed operating rules for the windpower systems and general conditions regarding wind speed and demand variations. In the model for windpower systems without storage, optimization is carried out with respect to the total capacity of windturbines that vary in the values of design parameters such as rotor diameter, tower height and wind speed at which maximum power is generated. The model for windpower systems with storage was developed for the case in which the average wind speeds in successive time increments show very low correlation. The model is then modified for the case of low serial correlation. An analytical storage model is used as a basis of representing storage requirements for a given system. Dissert. Abstr.

N76-22662* Battelle Columbus Labs., Ohio.

INVESTIGATION OF STORAGE SYSTEM DESIGNS AND TECHNIQUES FOR OPTIMIZING ENERGY CONSERVATION IN INTEGRATED UTILITY SYSTEMS. VOLUME 1: (EXECUTIVE SUMMARY) Final Report

10 Mar. 1976 30 p refs 3 Vol.

(Contract NAS9-14628)

(NASA-CR-147591) Avail: NTIS HC \$4.00 CSCL 10C

Integrated Utility Systems (IUS) have been suggested as a means of reducing the cost and conserving the nonrenewable energy resources required to supply utility services (energy, water, and waste disposal) to developments of limited size. The potential

for further improving the performance and reducing the cost of IUS installations through the use of energy storage devices is examined and the results are summarized. Candidate energy storage concepts in the general areas of thermal, inertial, superconducting magnetic, electrochemical, chemical, and compressed air energy storage are assessed and the storage of thermal energy as the sensible heat of water is selected as the primary candidate for near term application to IUS. Author

N76-22663*# Battelle Columbus Labs., Ohio.
INVESTIGATION OF STORAGE SYSTEM DESIGNS AND TECHNIQUES FOR OPTIMIZING ENERGY CONSERVATION IN INTEGRATED UTILITY SYSTEMS. VOLUME 2: (APPLICATION OF ENERGY STORAGE TO IUS) Final Report
 10 Mar. 1976 120 p refs 3 Vol.
 (Contract NAS9-14628)
 (NASA-CR-147592) Avail: NTIS HC \$5.50 CSCL 10C

The applicability of energy storage devices to any energy system depends on the performance and cost characteristics of the larger basic system. A comparative assessment of energy storage alternatives for application to IUS which addresses the systems aspects of the overall installation is described. Factors considered include: (1) descriptions of the two no-storage IUS baselines utilized as yardsticks for comparison throughout the study; (2) discussions of the assessment criteria and the selection framework employed; (3) a summary of the rationale utilized in selecting water storage as the primary energy storage candidate for near term application to IUS; (4) discussion of the integration aspects of water storage systems; and (5) an assessment of IUS with water storage in alternative climates. Author

N76-22664*# Battelle Columbus Labs., Ohio.
INVESTIGATION OF STORAGE SYSTEM DESIGNS AND TECHNIQUES FOR OPTIMIZING ENERGY CONSERVATION IN INTEGRATED UTILITY SYSTEMS. VOLUME 3: (ASSESSMENT OF TECHNICAL AND COST CHARACTERISTICS OF CANDIDATE IUS ENERGY STORAGE DEVICES) Final Report
 10 Mar. 1976 244 p refs 3 Vol.
 (Contract NAS9-14628)
 (NASA-CR-147593) Avail: NTIS HC \$8.00 CSCL 10C

Six energy storage technologies (inertial, superconducting magnetic, electrochemical, chemical, compressed air, and thermal) were assessed and evaluated for specific applicability to the IUS. To provide a perspective for the individual storage technologies, a brief outline of the general nature of energy storage and its significance to the user is presented. Author

N76-22665*# TRW Systems Group, Redondo Beach, Calif.
A STUDY OF GEOTHERMAL PROSPECTS IN THE WESTERN UNITED STATES Final Report
 20 Aug. 1975 147 p refs
 (Contracts NAS7-100; JPL-954243)
 (NASA-CR-147114; TRW-28455-6001-RU-00) Avail: NTIS HC \$6.00 CSCL 10B

The commercial development potential of 13 underdeveloped geothermal prospects in the western United States was examined and the prospects were ranked in order of relative potential for development on the basis of investment considerations. The following were considered in the ranking: geotechnical and engineering data, energy market accessibility, administrative constraints, and environmental and socio-economic factors. The Roosevelt, Utah, prospect ranks first in development potential followed in order by Beowawe, Nevada; Coso Hot Springs, California; Long Valley, California; and Brady's Hot Springs, Nevada. Author

N76-22666*# General Electric Co., Philadelphia, Pa.
FEASIBILITY STUDY OF A 200 WATT PER KILOGRAM LIGHTWEIGHT SOLAR ARRAY SYSTEM Quarterly Report, 19 Jan. - 31 Mar. 1976
 R. Stanhouse, J. Cokonis, and G. Rayl 15 Apr. 1976 144 p refs Prepared for JPL
 (Contracts NAS7-100; JPL-954393)
 (NASA-CR-146878; Doc-76SDS54214) Avail: NTIS HC \$6.00 CSCL 10A

Progress in an investigation of the feasibility of designing a lightweight solar array with a power-to-weight ratio of 200 watts per kilogram is described. This solar array will produce 10,000 watts of electrical power at 1 A.U. at its beginning of life (BOL), and degrade less than 20% over a three year period in interplanetary flight. A review of existing lightweight solar array system concepts is presented along with discussion pertaining to their applicable technology as it relates to a 200 watt/kilogram array. Also presented is a discussion of the candidate development solar cells being considered, and various deployable boom concepts under investigation. Author

N76-22667*# Texas Instruments, Inc., Dallas.
AUTOMATED ARRAY ASSEMBLY TASK, PHASE 1 Quarterly Report
 Bernard G. Carbajal and Samuel V. Rea Mar. 1976 31 p
 Prepared for JPL Sponsored by ERDA
 (Contract NAS7-100; JPL-954405)
 (NASA-CR-147165; QR-1; TI-03-76-13;
 ERDA/JPL-954405-76/954405-7-5) Avail: NTIS HC \$4.00 CSCL 10A

Work consisted primarily of preparing base line cost estimates for current solar cell processing technologies; preparing an initial design-to-cost goal breakdown; designing and beginning construction of an experimental solar cell module; and initiating the various activities that make up this task. The base line cost estimates show that current solar cell fabrication technology is about an order of magnitude too expensive as compared to the design-to-cost goals. In the area of solar cell fabrication, metallization is shown to be the least cost-effective process element. Author

N76-22668*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A SUMMARY OF THE ECAS PERFORMANCE AND COST RESULTS FOR MHD SYSTEMS
 G. R. Seikel, R. J. Sovie, R. K. Burns, G. J. Barna, J. A. Burkhart, J. J. Naingier, and J. M. Smith 1976 22 p refs Proposed for presentation at the Fifteenth Symp. on the Eng. Aspects of Magnetohydrodynamics, Philadelphia, 24-26 May 1976
 (NASA-TM-X-71913) Avail: NTIS HC \$3.50 CSCL 10B

The potential is examined of various advanced power plant concepts using coal and coal-derived fuel. The results indicate that open cycle coal fired direct preheat MHD systems have potentially one of the highest coal-pile-to-bus-bar efficiencies and; also one of the lowest costs of electricity (COE) of the systems studied. Closed cycle MHD systems may have the potential to approach the efficiency and COE of open cycle MHD. The 1200-1500 F. liquid metal MHD systems studied do not appear to have the potential of exceeding the efficiency or competing with the COE of advanced steam plants. Author

N76-22669# Select Committee on Small Business (U. S. House).
ENERGY DATA REQUIREMENTS OF THE FEDERAL GOVERNMENT. PART 2: OIL SHALE
 Washington GPO 1974 145 p refs Hearing before Subcomm. on Activities of Regulatory Agencies of Permanent Select Comm. on Small Business, 93d Congr., 2d Sess., 28 Jan. 1974
 (GPO-32-466) Avail: Subcomm. on Activities of Regulatory Agencies

The information and evaluation techniques by which the Department of the Interior determines the value of land leased in the oil shale program are examined. Recommendations are included. J.M.S.

N76-22670# Committee on Foreign Affairs (U. S. House).
THE ENERGY CRISIS: IMPACT ON DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN
 Washington GPO 1974 43 p Hearing before Subcomm. on Inter-American Affairs of Comm. on Foreign Affairs, 93d Congr., 2d Sess., 27 Mar. 1974
 (GPO-34-468) Avail: Subcomm. on Inter-American Affairs

The impact of the energy crisis on Latin America and the Caribbean is discussed. Factors considered include: decreasing energy and food supply, economic recession, and an accelerated power shift. J.M.S.

N76-22672* ECON. Inc., Princeton, N.J.

SPACE-BASED SOLAR POWER CONVERSION AND DELIVERY SYSTEMS STUDY Interim Summary Report

31 Mar. 1976 262 p refs

(Contract NAS8-31308)

(NASA-CR-144289; Rept-76-145-1B) Avail: NTIS HC \$9.00 CSCI 10A

Even at reduced rates of growth, the demand for electric power is expected to more than triple between now and 1995, and to triple again over the period 1995-2020. Without the development of new power sources and advanced transmission technologies, it may not be possible to supply electric energy at prices that are conducive to generalized economic welfare. Solar power is renewable and its conversion and transmission from space may be advantageous. The goal of this study is to assess the economic merit of space-based photovoltaic systems for power generation and a power relay satellite for power transmission. In this study, satellite solar power generation and transmission systems, as represented by current configurations of the Satellite Solar Station (SSPS) and the Power Relay Satellite (PRS), are compared with current and future terrestrial power generation and transmission systems to determine their technical and economic suitability for meeting power demands in the period of 1990 and beyond while meeting ever-increasing environmental and social constraints. Author

N76-22673# Committee on Finance (U. S. Senate).

ENERGY CONSERVATION AND CONVERSION ACT OF 1975, PART 1

Washington GPO 1975 464 p refs Hearings on H.R. 6860 before Comm. on Finance, 94th Congr., 1st Sess., 10, 11, 14-17 and 18 Jul. 1975

(GPO-55-583) Avail: SOD HC \$3.95

An act to provide a national energy conservation and conversion program is presented. Factors considered include: import oil-quotas, duties, and restrictions; automobile fuel mileage; intercity buses, radial tires, and re refined oil; tax incentives for energy related improvements of buildings; and an energy conservation and conversion trust fund. J.M.S.

N76-22674# Committee on Government Operations (U. S. Senate).

OVERSIGHT OF ENERGY CONSERVATION

Washington GPO 1975 974 p refs Hearings before Comm. on Govt. Operations, 94th Congr., 1st Sess., 16-18 Apr. 1975 (GPO-55-035) Avail: SOD HC \$7.50

Energy conservation measures adopted in the industrial, commercial, residential, transportation, and government sectors of the economy are discussed. Economic factors and energy shortages are considered in terms of voluntary measures vs. mandatory programs. J.M.S.

N76-22680# Catalytica Associates, Inc., Palo Alto, Calif.

NEW CATALYTIC MATERIALS FOR THE LIQUEFACTION OF COAL Final Report

M. Boudart, J. A. Cusumano, and R. B. Levy Oct. 1975 310 p refs

(PB-247618/2; EPRI-415-FR) Avail: NTIS HC \$9.75 CSCI 07D

Potential second-generation catalytic materials for the direct liquefaction of coal to boiler fuel are studied. Both fundamental aspects and engineering constraints were considered in evaluating materials and assigning a priority for further study. A synopsis of relevant background information, the nature of the study, and the evaluation of materials is presented along with a detailed analysis of the physical, chemical and catalytic properties of the materials which were reviewed, and a discussion of the relevance of the physical and chemical properties to catalysis. An evaluation of physical techniques currently used for the study of these properties and the general conclusions of the study are included. GRA

N76-22681# Colorado Univ., Boulder. Dept. of Mechanical Engineering.

HEAT AND MASS TRANSFER IN MODELS OF UNDEVELOPED

OPED GEOTHERMAL FIELDS

D. R. Kassoy 16 Jun. 1975 27 p refs Presented at the United Nations Geothermal Symp., San Francisco, May 1975 (Grant NSF AER-74-03429)

(PB-247123/3; CUMER-75-7; NSF/RA/N-75-120) Avail: NTIS HC \$4.00 CSCI 08G

A brief summary is given of the nondimensional equations and relevant parameters to be used for describing convection processes in the geothermal setting. Characteristic estimates of flow rates and pressure variation (beyond the hydrostatic value) are given. It is shown that the complete equation system can be reduced in complexity by neglecting terms which describe physically insignificant effects. The resulting equations are used to consider the onset of convection in a horizontal saturated porous slab when a realistic model of viscosity variation is used. It is shown that the classical constant viscosity prediction is in error both quantitatively and qualitatively. A calculation is made for the rate of convective flow in a model fault zone. GRA

N76-22682# Colorado Univ., Boulder. Dept. of Mechanical Engineering.

A SUBSURFACE STUDY OF THE MESA GEOTHERMAL ANOMALY, IMPERIAL VALLEY, CALIF.

H. T. Black 5 May 1975 67 p refs

(Grant NSF AER-74-03429)

(PB-247082/1; CUMER-75-5; NSF/RA/N-75-126) Avail: NTIS HC \$4.50 CSCI 08G

A subsurface study of the geological characteristics of the Mesa anomaly is carried out based largely on well logs and histories of five geothermal wells in the area. The coincident resistivity thermal and gravity anomalies are connected with the presence of hot, saline water convecting in a hydrothermally altered fractured system. The system is apparently associated with the intersection of several near-vertical faults. Hot water rising from depth in the fault zone region spreads laterally below the 2500 ft. level merging with the regional northwestern ground water flow pattern. GRA

N76-22683# Federal Energy Administration, Washington, D.C. Office of Analysis, Evaluation and Systems Studies.

THE POTENTIAL FOR ENERGY SAVINGS THROUGH REDUCTIONS IN HOT WATER CONSUMPTION

Apr. 1975 49 p

(PB-247370/0; FEA/D-75/453) Avail: NTIS HC \$3.50 CSCI 10A

America's patterns of heated water use are studied. The energy savings obtained from various methods of using hot water are considered along with the economic, social, and institutional problems involved in using hot water. Recommendations for legislation concerning hot water consumption are included. Energy conservation measures are proposed. GRA

N76-22684# Illinois Univ., Champaign. Center for Advanced Computation.

NUCLEAR POWER TO 1985: POSSIBLE VERSUS OPTIMISTIC ESTIMATES, APPENDIX A Final Report

Michael Rieber and Ronald Halcrow May 1975 206 p refs (Grant NSF GI-35821)

(PB-248061/4; CAC-163-App-A; NSF/RA/N-75-037A) Avail: NTIS HC \$7.75 CSCI 10A

The following topics are discussed: the cost of nuclear power; nuclear power forecasts and power availability; fuel cycle costs; uranium costs, uranium reserves, uranium prices; uranium pricing factors; fuel cycle component costs, background material; capital and related costs. GRA

N76-22685# Illinois Univ., Champaign. Center for Advanced Computation.

THE COAL FUTURE: ECONOMIC AND TECHNOLOGICAL ANALYSIS OF INITIATIVES AND INNOVATIONS TO SECURE FUEL SUPPLY INDEPENDENCE Final Report, Apr. 1974 - May 1975

Michael Rieber, Shao Lee Soo, and James Stuckel May 1975 227 p refs

(Grant NSF GI-35821)

(PB-247678/6; UIUC-CAC-DN-75-163; NSF/RA/N-75-037)
 Avail: NTIS HC \$8.00 CSCL 10A

Nuclear power costs are reevaluated to determine the ceiling price for coal. Low sulfur coal reserves are reestimated on a consumer rather than on an as mined basis. Coal reserve/resource estimating procedures are analyzed for their policy content. Comparative cost estimates are developed for unit trains, slurry pipelines and high pressure pneumatic pipelines. Low Btu coal gasification and stack gas scrubbing are compared for SO₂ removal. An analysis of medium Btu coal gasification to increase coal markets is made. GRA

N76-22686# Research Triangle Inst., Research Triangle Park, N.C.

RANN UTILIZATION EXPERIENCE. CASE STUDY NO. 14: CONSERVING ENERGY

D. N. Morris (RAND Corp., Santa Monica, Calif.) and R. M. Burger 1975 27 p refs
 (Contract NSF C-927)

(PB-247258/7; NSF/RA/G-75-042) Avail: NTIS HC \$4.00 CSCL 10A

Rand's energy policy study, beginning long before the energy crisis of 1973-74, aimed at understanding the interactions between energy demand and supply, and at developing measures for conserving energy. The research products--reports on industrial energy demand, effects of fuel price increases and projections of electrical energy demand, were designed to give policymakers information on the policy alternatives in managing the nation's energy supplies and their consequences. This report briefly reviews use of the study results. GRA

N76-22688# Research Triangle Inst., Research Triangle Park, N.C.

RANN UTILIZATION EXPERIENCE. CASE STUDY NO. 20: ENERGY AND ENVIRONMENT

R. S. Carlsmith 1975 26 p refs Prepared in part by Oak Ridge Natl. Lab.
 (Contract NSF C-927)

(PB-247263/7; NSF/RA/G-75-048) Avail: NTIS HC \$4.00 CSCL 10A

This program supports the following activities: (1) performance of energy research, (2) collection and analysis of energy data from many sources, and (3) dissemination of energy-related information to individuals, companies, and agencies. The program has pursued three broad areas: energy conservation, studies of coal systems, and information on energy research. There are both theoretical and experimental aspects. This report briefly discusses the reception of the research products, disseminated through technical reports, professional meetings, and personal contacts. GRA

N76-22689# Research Triangle Inst., Research Triangle Park, N.C.

RANN UTILIZATION EXPERIENCE. CASE STUDY NO. 13: CONTINUOUS FABRICATION OF SOLAR CELLS

B. Chalmers and A. I. Mlavsky 1975 25 p Prepared in cooperation with Tyco Labs., Inc., Waltham, Mass. and Harvard Univ., Cambridge, Mass.
 (Contract NSF C-927)

(PB-247257/9; NSF/RA/G-75-041) Avail: NTIS HC \$3.50 Also included in complete report and summary PB-247243. HC \$13.00 CSCL 10B

The objective of this research project is to develop the technology of 'edge-defined, film-fed growth' (EFG), the continuous production of crystal silicon ribbons suitable for manufacturing low-cost silicon solar cells. Various factors have combined to make this research useful to those individuals or industries contemplating methods for mass production of solar cells. GRA

N76-22690# Massachusetts Univ., Amherst. Energy Alternatives Program.

TECHNICAL AND ECONOMIC FEASIBILITY OF THE OCEAN THERMAL DIFFERENCES PROCESS Semiannual Progress Report, 1 Jan. - 30 Jun. 1975

C. R. Adams, W. E. Heronemus, L. L. Ambs, R. H. Kirchoff, and A. Chajes 1 Sep. 1975 84 p refs
 (Grant NSF GI-34979)

(PB-247078/9; NSF/RANN/SE/GI-34979/PR-75-2;

NSF/RA/N-75-114) Avail: NTIS HC \$5.00 CSCL 10B

The technical and economic feasibility of at least one total system capable of delivering an energy product using the ocean thermal differences solar-energy process is measured. Progress on further description of the total system, major subsystems and components is summarized. GRA

N76-22691# Federal Energy Administration, Washington, D.C. Office of Energy Data Policy.

ENERGY INFORMATION IN THE FEDERAL GOVERNMENT: ENERGY INFORMATION LOCATOR SYSTEM

J. Paul Galliker Nov. 1975 1019 p

(PB-246703/3; FEA/B-75/375) Avail: NTIS HC \$28.25 CSCL 10A

Energy and energy-related programs from 44 agencies, bureaus, and commissions in the Federal Government are described. The identification process is developed by the aggregation of energy data descriptors/characteristics (i.e., data on the geographic location of anthracite coal exploration) by the use of energy function matrices that are displayed which, in turn, are linked to subsequent Federal agency summaries and their energy program summaries. A description Directory of 98 existing energy data bases and files is also contained in addition to an overview of the project, techniques and documents employed in the collection of the data. GRA

N76-22694# Virginia Univ., Charlottesville. School of Engineering and Applied Science.

PROCEEDINGS OF THE WORKSHOP ON SOLAR HEATING AND COOLING OF BUILDINGS

F. Anthony Iachetta, J. Taylor Beard, and Lembit U. Lilleleht 1975 170 p Prepared in cooperation with Am. Soc. of Heating, Refrigerating and Air Conditioning Eng. Inc.
 (Grant NSF GI-43965)

(PB-247153/0; NSF/RA/N-74-126) Avail: NTIS HC \$6.75 CSCL 13A

The Workshop on the Solar Heating and Cooling of Buildings was convened to make available to the public the findings of the NSF/RANN sponsored Phase 0 feasibility studies on solar heating and cooling of buildings and the results of a number of solar heating experiments. Topic areas covered feasibility; technical and economic considerations; environmental, social, and political aspects; advanced research; and solar heating and cooling experiments. GRA

N76-22695# Westinghouse Electric Corp., Pittsburgh, Pa. THE ac/dc POWER CONDITIONING AND CONTROL EQUIPMENT FOR ADVANCED CONVERSION AND STORAGE TECHNOLOGY Key Phase Report

Peter Wood Aug. 1975 362 p refs

(PB-247217/3; EPRI-RP390-1-1; Rept-1) Avail: NTIS HC \$10.50 CSCL 10B

The best power conversion technologies are established that are applicable to a number of advanced energy storage conversion technologies, including a study of common conversion technology, modular approach to construction costs, research needed prior to practical application, and a preliminary design of the best technology. It was concluded that a common technology can be applied to all sources considered, excepting flywheels, and that a current-fed, naturally commutated inverter is the best short term candidate. GRA

N76-22696# National Governors' Conference, Washington, D.C. Center for Policy Research and Analysis.

STATE ENERGY INFORMATION SYSTEMS: A SURVEY

J. D. DeForest Jul. 1975 64 p

(Grant EDA-99-6-09374)

(PB-247457/5; NATGOV-76/1) Avail: NTIS HC \$4.50 CSCL 10A

State level activities in the energy systems area are discussed. The report contains a list of state energy contacts and recommends

actions by state governments which could improve the quality of energy information. An overview of energy activities underway in the states is presented. GRA

N76-22697# Oregon State Univ., Corvallis. Water Resources Research Inst.

THE USE OF WASTE HEAT IN A SYSTEM FOR ANIMAL WASTE CONVERSION WITH BY-PRODUCT RECOVERY AND RECYCLING

L. Boersma, E. W. R. Barlow, J. R. Miner, H. K. Phinney, and J. E. Oldfield Oct. 1975 41 p refs
(Contract DI-14-31-0001-4121)
(PB-247555/6; WRRI-38; W76-01806; OWRT-B-039-ORE(3))
Avail: NTIS HC \$4.00 CSCL 02C

Society faces many problems related to the consumptive use of nonrenewable natural resources and the environmental degradation resulting from pollution. An animal waste management scheme was developed on the premise that one solution to these problems is the development of integrated production systems with recycled resources. It is proposed to use microorganisms to convert animal waste into a high protein animal feed and a methane-rich fuel gas. A conceptual design for such a system is described and results are presented of preliminary experiments conducted in the laboratory. GRA

N76-22699# National Bureau of Economic Research, Inc., Washington, D.C.

CONFERENCE ON ECONOMETRICS AND MATHEMATICAL ECONOMICS. WORKSHOP ON ENERGY-RELATED GENERAL RESEARCH IN MICRO-ECONOMICS

Robert Solow (MIT), Joseph Stiglitz (Stanford Univ.), and Gary Fromm May 1975 72 p refs Presented at the Conf. on Nat. Resources, Palo Alto, Calif., 9-11 May 1975
(Grant NSF SOC-74-20175)
(PB-247466/6) Avail: NTIS HC \$4.50 CSCL 05C

The principles of microeconomics theory were applied to the discovery, extraction, and utilization of natural resources. Sixteen papers are summarized in the workshop report. These papers fall into four general categories: optimal extraction of natural resources; market structure and intertemporal allocation; special problems of exploration and leasing; and the economics of renewable resources. Conference participants also identified an agenda of research in these areas that remained to be done. GRA

N76-22700# Research Triangle Inst., Research Triangle Park, N.C.

RANN UTILIZATION EXPERIENCE. CASE STUDY NO. 16. TRANSPORTABLE SOLAR LABORATORY

R. LeChevalier 1975 25 p Prepared in cooperation with Honeywell, Inc., Minneapolis, Minn.
(Contract NSF C-927)
(PB-247079/7; NSF/RA/G-75-044) Avail: NTIS HC \$3.50
Also included in complete report and summary, PB-247243, HC \$13.00 CSCL 13A

The primary objectives of the Transportable Solar Laboratory (TSL) project are to collect data on the performance of a solar energy conversion system, to test that system and its components in actual operation, and to communicate the potential of solar energy conversion systems to community leaders in education, engineering, science, government, and industry. The report briefly discusses use of the TSL. GRA

N76-22704# National Energy Information Center, Washington, D.C.

DIRECTORY OF STATE GOVERNMENT ENERGY-RELATED AGENCIES

Neal Moerschel Sep. 1975 235 p
(PB-246891/6; FEA/C-75/515) Avail: NTIS HC \$8.00 CSCL 10A

The Directory represents the comprehensive effort of the National Energy Information Center to serve as a national central clearinghouse for energy information. Nine categories of state government energy-related organizations and contacts are

identified and include: (1) primary energy agencies; (2) energy conservation; (3) energy facilities siting; (4) comprehensive land use planning; (5) coastal zone management; (6) environmental impact assessments; (7) public utility regulation; (8) legislative committee; and (9) legislative service agencies. GRA

N76-22706# Environmental Policy Inst., Washington, D.C.
THE NEED FOR ENERGY FACILITY SITES IN THE UNITED STATES: 1985 THROUGH 2000 Final Report

Marc Messing 30 Jun. 1975 68 p refs
(Contract EQ5AD272)
(PB-248153/9; EQ-517514272) Avail: NTIS HC \$4.50 CSCL 10A

The Federal Energy Administrations's (FEA's) projections for needed new facilities are analyzed by comparing FEA's data base and forecast methodology used in the Project Independence Report with other estimates of total energy and electrical energy demands. Estimates of the demand for new facilities are compared with current utility plans for new facilities through 1985, and the number of new sites necessary to meet projected facility demands is estimated. A survey of current state laws and provisions for meeting demands on the state level is included. GRA

N76-22707# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PULSE SOURCE OF ENERGY FOR THE FEED OF A PINCH WITH LINER TYPE SET-UP

M. V. Bystrov, V. A. Krylov, B. A. Larionov, V. P. Silin, and A. M. Stolz 28 Nov. 1975 15 p refs Transl. into ENGLISH from Russian Conf. Amerikanskii Seminar, Doklad. (Leningrad). 23-27 Sep. 1975 p 1-10
(AD-A018532; FTD-ID(RS))-(2381-75) Avail: NTIS CSCL 18/3

In connection with the development of work on a pulse thermonuclear reactor, the creation of pulse sources of feed with a large reserve of energy and duration of its output .0001 and longer is of special current interest. During the development of these sources on the basis of induction collectors of energy, a whole series of problems arise, connected with the design of the collector itself and the realization of fast output of energy using commutating devices with great power, as well as with the design agreement of the collector with the complex of disconnection devices. The induction collectors of toroidal configuration, despite slightly worse overall weight indicators compared with cylindrical collectors, have a number of advantages for short-pulse systems, including: (a) symmetrical arrangement of the sections of the collector, eliminating additional losses in energy in the multiplication circuits of the currents with the parallel connection of the sections; (b) significant weakening of the external fields compared with cylindrical collectors; and (c) the possibility of symmetrical arrangement of the commutating equipment and the ensurance of the mechanical strength of the construction as a whole. GRA

N76-22709# Washington Univ., St. Louis, Mo. Center for the Biology of Natural Systems.

DEVELOPMENT OF STRATEGIES TO REDUCE THE VULNERABILITY OF UNITED STATES AGRICULTURE TO DISRUPTIONS FROM ENERGY SHORTAGES AND PRICE INCREASES, FIRST YEAR REPORT Annual Report, Jun. 1974 - Jul. 1975

1 Aug. 1975 13 p refs
(Grant NSF GI-043890)
(PB-248288/3; NSF/RA/N-75-169) Avail: NTIS HC \$3.50 CSCL 02B

The adverse effects that energy shortages and price increases could have on U.S. agriculture are identified, and alternative production strategies to minimize these effects are evaluated. This study develops an energy vulnerability index to estimate how seriously both energy shortages and price increases could disrupt the production of major agricultural commodities. It also analyzes production methods, comparing the energy use of conventional production methods (high in application of nitrogen

fertilizers and synthetic pesticides) with that of organic production methods. GRA

N76-22711# Mitre Corp., McLean, Va.
EPA PROGRAM STATUS REPORT, SYNTHETIC FUELS PROGRAM Final Report
 Bruce Truett, Robert G. Murray (Stanford Res. Inst., Menlo Park., Calif.), and Gary Foley (EPA, Washington, D. C.) Oct. 1975
 32 p refs
 (Contract EPA-68-01-2940)
 (PB-247140/7; EPA-600/2-75-070) Avail: NTIS HC \$4.00
 CSCL 21D

The status of EPA's Synthetic Fuels Program as of September, 1974 is presented in nontechnical language. This program is a part of EPA's work directed toward providing the necessary technology for meeting near-term and long-term energy requirements in an environmentally acceptable manner. The program is aimed at controlling and preventing environmental pollution when coal and other fossil hydrocarbons are converted to synthetic fuels and are used as products. Program objectives and responsibility are presented in relation to funding level. Significant accomplishments of the program are summarized, and the thrust of future research is discussed. GRA

N76-22712# Institute of Gas Technology, Chicago, Ill.
UTILIZATION OF OFF-PEAK POWER TO PRODUCED INDUSTRIAL HYDROGEN Final Report
 Nicholas Bierderman, Kenneth Darrow, Jr., and Alex Konopka
 Aug. 1975 195 p refs
 (IGT Proj. 8793)
 (PB-247219/9; EPRI-230-1-FR) Avail: NTIS HC \$7.50 CSCL 21D

An analytical methodology for determining the economic and technical feasibility of using off-peak power to generate hydrogen that can be sold to industry as a fuel or commodity was developed. Such a scheme might represent an attractive use of off-peak power and could provide the first step toward building a hydrogen-energy system. Specialty markets that seem most susceptible to the use of off-peak-produced hydrogen, the economics of electrolytic hydrogen production, a techno-economic discussion of hydrogen storage and transportation, and the methodology by which a utility can initially evaluate the possibilities of supplying a particular hydrogen user in its service area with hydrogen produced from off-peak electric power are discussed. GRA

N76-22713*# Grumman Aerospace Corp., Bethpage, N.Y.
SPACE-BASED SOLAR POWER CONVERSION AND DELIVERY SYSTEMS (STUDY), ENGINEERING ANALYSIS
 C. A. Nathan 6 Aug. 1975 78 p
 (Contract NAS8-31308)
 (NASA-CR-144252; A31640; GAC-NSS-P-75-001) Avail: NTIS HC \$5.00 CSCL 10A

A systems analysis of synchronous, orbit-based power generation and relay systems that could be operational in the 1990's is described along with a comparison with earth-based systems to be operational in the same time frame. Operational and economic requirements for the orbiting systems and near-term research activities which will be required to assure feasibility, development, launch and operational capabilities of such systems, in the post-1990 time frame are examined. Author

N76-22716 California Univ., Los Angeles.
ENVIRONMENTAL ISSUES IN THE SITING, CONSTRUCTION AND OPERATION OF NEW COAL-FIRED AND NUCLEAR POWER PLANTS Ph.D. Thesis
 Anthony Francis Moscati, Jr. 1975 197 p
 Avail: Univ. Microfilms Order No. 76-9004

A discussion is presented of some of the major interfaces between efforts toward environmental preservation and the expansion of the nation's power supply. Ways in which environmental goals may be attained within the framework of a comprehensive energy policy are also discussed. Emphasis is placed on the environmental issues encountered in the siting,

construction, and operation of new coal-fired and nuclear power stations; no attempt is made to evaluate environmental aspects of such related activities as fuel mining, processing, and recycling. Recommendations made concerning the integration of environmental concerns into the regulatory framework include suggestions for streamlining the environmental review process. Dissert. Abstr.

N76-22717 Purdue Univ., Lafayette, Ind.
OPTIMAL AND SUBOPTIMAL CONTROL OF AUTOMOTIVE ENGINE EFFICIENCY AND EMISSIONS Ph.D. Thesis
 Ramachandra Prabhakar 1975 341 p
 Avail: Univ. Microfilms Order No. 76-7119

The engineering problem treated is the development of a control scheme to reduce emissions without undue loss in fuel economy. As an adjunct to this work the problem of reducing fuel consumption without regard for emission control is also treated. The control variables used are air-fuel ratio, exhaust gas recirculation, and spark advance. Vehicles equipped with conventional internal combustion engines are studied. No exhaust treatment devices, as for example the catalytic converter, are used for emission reduction. Exhaust emission rates are modeled using empirical correlation techniques. The techniques were applied to two different vehicles, a 1970 Ford Thunderbird and a 1971 Chevrolet. The results indicate that the functional forms are applicable for different designs of internal combustion engines. Dissert. Abstr.

N76-22733# Exxon Research and Engineering Co., Linden, N.J.
EVALUATION OF POLLUTION CONTROL IN FOSSIL FUEL CONVERSION PROCESSES. GASIFICATION: SECTION 6 (HYGAS PROCESS) Final Report
 C. E. Jahnig Aug. 1975 60 p refs
 (Contract EPA-68-02-0629)
 (PB-247225/6; EXXON/GRU.11DJ.75; EPA-650/2-74-009-h) Avail: NTIS HC \$4.50 CSCL 07A

The quantities of solid, liquid, and gaseous effluents were estimated, where possible, as well as the thermal efficiency of the process. For the purpose of reduced environmental impact, a number of possible process modifications or alternatives which could facilitate pollution control or increase thermal efficiency were proposed, and new technology needs were pointed out. GRA

N76-22734# Exxon Research and Engineering Co., Linden, N.J.
EVALUATION OF POLLUTION CONTROL IN FOSSIL FUEL CONVERSION PROCESSES. GASIFICATION: SECTION 7 (U-GAS PROCESS) Final Report
 C. E. Jahnig Sep. 1975 46 p refs
 (Contract EPA-68-02-0629)
 (PB-247226/4; EXXON/GRU.12DJ.75; EPA-650/2-74-009-i) Avail: NTIS HC \$4.00 CSCL 07A

Results are given for the U-Gas Process from the standpoint of its effect on the environment. The quantities of solid, liquid, and gaseous effluents were estimated, where possible, as well as the thermal efficiency of the process. For the purpose of reducing environmental impact, a number of possible alternatives are discussed, and technology needs are pointed out. GRA

N76-23057# Committee on Government Operations (U. S. Senate).

RECYCLING OF PETRODOLLARS

Washington GPO 1974 99 p refs Hearing before Permanent Subcomm. on Investigations of Comm. on Govt. Operations, 93d Congr., 2d Sess., 16 Oct. 1974
 (GPO-42-306) Avail: Subcomm. on Investigations

The financial and economic problems that have accompanied the artificial inflation of world oil prices by the OPEC cartel are considered. Emphasis is placed on the concept of recycling the process by which the oil consumers are expected to borrow back their own money from OPEC in order to buy more oil at inflated prices. Conservation of fuel oil is recommended to decrease the demand for OPEC oil. J.M.S.

N76-23059# Committee on Armed Services (U. S. House). **FULLY EXPLORE, FULLY DEVELOP, AND PRODUCE THE NAVAL PETROLEUM RESERVES WITH THE REVENUE DERIVED THEREFROM TO BE PLACED IN A SPECIAL FUND FOR SUCH EXPLORATION, DEVELOPMENT, AND PRODUCTION, FOR PRODUCTION TO BE APPLIED TO THE PETROLEUM NEEDS OF THE DEPARTMENT OF DEFENSE AND FOR THE ESTABLISHMENT OF A STUDY GROUP TO INVESTIGATE THE FEASIBILITY OF CREATING A NATIONAL STRATEGIC PETROLEUM (MILITARY), AND FOR OTHER PURPOSES**

Washington GPO 18 Apr. 1975 21 p Rept. to accompany H. R. 5919, 94th Congr., 1st Sess., 18 Apr. 1975 (H-Rept-94-156; GPO-38-006) Avail: US Capitol, House Document Room.

The history and location of the four Naval petroleum reserves are briefly described along with the readiness and deliverability of the oil from each reserve. A summary is included of the proposed legislation to increase domestic energy supply and availability. F.O.S.

N76-23061# Committee on Interior and Insular Affairs (U. S. House).

AUTHORIZING THE SECRETARY OF THE INTERIOR TO ESTABLISH ON CERTAIN PUBLIC LANDS OF THE US NATIONAL PETROLEUM RESERVES THE DEVELOPMENT OF WHICH NEEDS TO BE REGULATED IN A MANNER CONSISTENT WITH THE TOTAL ENERGY NEEDS OF THE NATION AND FOR OTHER PURPOSES

Washington GPO 18 Mar. 1975 10 p Rept. of accompany H.R. 49, 94th Congr., 1st Sess., 18 Mar. 1975 (H-Rept-94-81-Pt-1; GPO-38-081) Avail: US Capitol, House Documentation Room

Legislation is presented and discussed that empowers the Secretary of the Interior to promote the exploration and drilling for crude oil in public lands of the United States. Specifically examined is the expansion of production of Naval petroleum reserves in Elk Hills, California, which contain an estimated 1.5 billion barrels of oil, and 1.2 trillion cubic feet of natural gas. The development of oil reserves in Alaska is also discussed. The development of these reserves should help relieve the Nation's dependence on foreign oil, and the energy crisis. J.R.T.

N76-23062# Committee on Armed Services (U. S. House). **AUTHORIZING THE SECRETARY OF THE INTERIOR TO ESTABLISH ON CERTAIN PUBLIC LANDS OF THE UNITED STATES NATIONAL PETROLEUM RESERVES THE DEVELOPMENT OF WHICH NEEDS TO BE REGULATED IN A MANNER CONSISTENT WITH THE TOTAL ENERGY OF THE NATION, AND FOR OTHER PURPOSES**

Washington GPO 18 Apr. 1975 27 p Rept. to accompany H.R. 49, 94th Congr., 1st Sess., 18 Apr. 1975 (H-Rept-94-81-Pt-2; GPO-38-006) Avail: US Capitol, House Document Room

N76-23064# Committee on Interstate and Foreign Commerce (U. S. House).

ELECTRIC UTILITY PROBLEMS: FUEL ADJUSTMENT CLAUSES

Washington GPO 1975 739 p refs Hearings before Subcomm. on Oversight and Investigations of Comm. on Interstate and Foreign Commerce, 94th Congr., 1st Sess., 1-2 and 5 May 1975

(GPO-54-363) Avail: Subcomm. on Oversight and Investigations

Fuel adjustment clauses used by electric utilities to pass on increased fuel costs to the consumer are discussed. Factors considered include: the position of the state regulatory agencies and the administration of the fuel adjustment clause; the utilities incentive to control costs and operate efficiently; and consumer protection. J.M.S.

N76-23249*# ECON, Inc., Princeton, N.J.
AN ASSESSMENT OF THE BENEFITS OF THE USE OF

NASA DEVELOPED FUEL CONSERVATIVE TECHNOLOGY IN THE US COMMERCIAL AIRCRAFT FLEET

6 Oct. 1975 84 p refs Revised

(Contract NASw-2781)

(NASA-CR-148148; Rept-75-163-1) Avail: NTIS HC \$5.00 CSDL 01C

Cost and benefits of a fuel conservative aircraft technology program proposed by NASA are estimated. NASA defined six separate technology elements for the proposed program: (a) engine component improvement (b) composite structures (c) turboprops (d) laminar flow control (e) fuel conservative engine and (f) fuel conservative transport. There were two levels postulated: The baseline program was estimated to cost \$490 million over 10 years with peak funding in 1980. The level two program was estimated to cost an additional \$180 million also over 10 years. Discussions with NASA and with representatives of the major commercial airframe manufacturers were held to estimate the combinations of the technology elements most likely to be implemented, the potential fuel savings from each combination, and reasonable dates for incorporation of these new aircraft into the fleet. Author

N76-23250*# Boeing Vertol Co., Philadelphia, Pa.

IDENTIFYING AND ANALYZING METHODS FOR REDUCING THE ENERGY CONSUMPTION OF HELICOPTERS

S. J. Davis and H. J. Rosenstein Nov. 1975 267 p refs

(Contract NAS1-13624)

(NASA-CR-144953; D210-11007-1) Avail: NTIS HC \$9.00 CSDL 01C

The results are presented of a study to identify those helicopter technology areas which would result in the largest energy (or fuel) savings when applied to large tandem (100 passenger) civil helicopters in the 1985 time frame. Baseline aircraft using 1975 technology in the areas of powerplant, rotor efficiency, parasite drag and structure were sized to a very short haul mission of 100 N.M. and a short haul mission of 200 N.M. A systematic parametric analysis was then conducted to assess the impact of technology improvements. Projections of the technology levels that could be obtained in the 1985 time frame were made and the resources estimated to achieve them. Based on these data, the highest payoff (lowest energy) helicopter technologies are identified. Author

N76-23447# Addis Translations International, Portola Valley, Calif.

ON THE TRAIL OF NEW FUELS, ALTERNATIVE FUELS FOR MOTOR VEHICLES

Sep. 1975 395 p refs Transl. into ENGLISH from Neuen Kraftstoffen auf der spur. Alternative Kraftstoffe fuer Kraftfahrzeuge (Germany), 1974 p 1-282 Sponsored by ERDA

(UCRL-Trans-10879) Avail: NTIS HC \$22.75

Motor vehicle alternate fuels are studied which will alleviate the pollution and supply problems presented by the use of gasoline. Topics include: (1) an index of researchers; (2) properties of methanol and methyl fuel; (3) availability of the raw materials; (4) production of methanol; (5) ocean transport, storage, and inland distribution; (6) vehicle requirements and safety problems; (7) methanol operation of conventional vehicles; (8) methanol operation of other propulsion systems; (9) fuel cells and gas generators; and (10) a list of references. Likely prospects for alternate fuels are methanol in the short and intermediate term and hydrogen in the long term. For both these fuels, the manufacture does not depend on oil, combustion engines of known construction can be used, and these fuels can be substituted for gasoline in steps. ERA

N76-23649*# Martin Marietta Corp., Denver, Colo.

EREP GEOTHERMAL Final Report

E. W. Johnston, Principal Investigator, A. L. Dunklee, and D. C. Wychgram 9 Aug. 1974 72 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS8-24000)

(E76-10322; NASA-CR-147655; MSC-05538) Avail: NTIS HC \$4.50 CSCL 10B

The author has identified the following significant results. A reasonably good agreement was found for the radiometric temperatures calculated from the ground truth data and the radiometric temperatures measured by the S192 scanner. This study showed that the S192 scanner data could be used to create good thermal images, particularly with the x-5 detector array.

N76-23670# Committee on Science and Technology (U. S. House).

THE ENERGY RELATED APPLICATIONS OF HELIUM

Washington 1975 578 p refs Hearing before Subcomm. on Energy Res., Development and Demonstration of Comm. on Sci. and Technol., 94th Congr., 1st Sess., No. 10, 7 May 1975 (GPO-54-198) Avail: Subcomm. on Energy Res., Development and Demonstration

The limited supplies and conservation of helium are considered in terms of potential energy related uses. Technologies utilizing helium considered include: superconducting power transmission, superconducting magnetic energy storage and fusion reactors. Cumulative helium requirements are estimated through the year 2030 along with the cost of extracting helium from the atmosphere and natural gas. Private storage of excess helium to meet future demands is recommended. J.M.S.

N76-23675* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

SOLAR ENERGY POWER SYSTEM Patent

Billy K. Davis, inventor (to NASA) Issued 18 May 1976 8 p Filed 21 Mar. 1975 Supersedes N75-29548 (13 - 20, p 2541) Division of US Patent Appl. SN-421702, filed 4 Dec. 1973, US - Patent-3,903,699

(NASA-Case-MFS-21628-2; US-Patent-3,957,030;

US-Patent-Appl-SN-561020; US-Patent-Class-126-270;

US-Patent-Class-165-133; US-Patent-Appl-SN-421702;

US-Patent-3,903,699) Avail: US Patent Office CSCL 10A

A solar energy vapor (Freon) powered system is described for generating electrical energy in which a portion of the heat absorbed from the sun in daylight is stored for use during darkness by a thermal capacitor in which a mass of Pyrene, having a high thermal capacity, liquifies when heat is applied to it and goes through a solidification process to provide a heat output. A highly efficient solar boiler is constructed utilizing an anodized titanium surface and a particular combination of shaped boiler tubes and complementary reflectors. The overall efficiency of the system is further improved by a unique arrangement of heat recovery devices. Official Gazette of the U.S. Patent Office

N76-23677 Tennessee Univ., Knoxville.

MODELING OF OPERATING FOSSIL FIRED POWER PLANTS: AN APPLICATIONS APPROACH Ph.D. Thesis

George Franklin Pierce 1975 114 p

Avail. Univ. Microfilms Order No. 76-11081

Suitable models of several existing control loops in an operating fossil fired plant are developed. Parameters for these models are developed without disruptive tests. A unique application of describing function analysis is developed and applied to the governor system. Capacity and dynamic models of the pulverizer system are developed. A new control strategy for the pulverizer system is proposed and studied. The models developed are used to demonstrate how improved plant control, reliability and economy could be achieved. Dissert. Abstr.

N76-23679*# General Electric Co., Schenectady, N.Y.

ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), GENERAL ELECTRIC PHASE 1. VOLUME 1: EXECUTIVE SUMMARY Final Report

J. C. Corman Feb. 1976 54 p Sponsored in part by ERDA and NSF 3 Vol.

(Contract NAS3-19406)

(NASA-CR-134948-Vol-1; SRD-76-011-Vol-1) Avail: NTIS HC \$4.50 CSCL 10B

A data base for the comparison of advanced energy conversion systems for utility applications using coal or coal-derived fuels was developed. Estimates of power plant performance (efficiency), capital cost, cost of electricity, natural resource requirements, and environmental intrusion characteristics were made for ten advanced conversion systems. Emphasis was on the energy conversion system in the context of a base loaded utility power plant. All power plant concepts were premised on meeting emission standard requirements. A steam power plant (3500 psig, 1000 F) with a conventional coal-burning furnace-boiler was analyzed as a basis for comparison. Combined cycle gas/steam turbine system results indicated competitive efficiency and a lower cost of electricity compared to the reference steam plant. The Open-Cycle MHD system results indicated the potential for significantly higher efficiency than the reference steam plant but with a higher cost of electricity. Author

N76-23680*# General Electric Co., Schenectady, N.Y.

ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), GENERAL ELECTRIC PHASE 1. VOLUME 2: ADVANCED ENERGY CONVERSION SYSTEMS. PART 1: OPEN-CYCLE GAS TURBINES Final Report

D. H. Brown and J. C. Corman Feb. 1976 97 p refs Sponsored in part by ERDA and NSF 3 Vol.

(Contract NAS3-19406)

(NASA-CR-134948-Vol-2-Pt-1; SRD-76-011-Vol-2-Pt-1) Avail: NTIS HC \$5.00 CSCL 10B

Ten energy conversion systems are defined and analyzed in terms of efficiency. These include: open-cycle gas turbine recuperative; open-cycle gas turbine; closed-cycle gas turbine; supercritical CO₂ cycle; advanced steam cycle; liquid metal topping cycle; open-cycle MHD; closed-cycle inert gas MHD; closed-cycle liquid metal MHD; and fuel cells. Results are presented. J.M.S.

N76-23681*# General Electric Co., Schenectady, N.Y.

ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), GENERAL ELECTRIC PHASE 1. VOLUME 2: ADVANCED ENERGY CONVERSION SYSTEMS. PART 2: CLOSED TURBINE CYCLES Final Report

D. H. Brown, J. C. Corman, and R. B. Fleming Feb. 1976 96 p refs Sponsored in part by ERDA and NSF 3 Vol.

(Contract NAS3-19406)

(NASA-CR-134948-Vol-2-Pt-2; SRD-76-011-Vol-2-Pt-2) Avail: NTIS HC \$5.00 CSCL 10B

For abstract, see N76-23680.

N76-23682*# General Electric Co., Schenectady, N.Y.

ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), GENERAL ELECTRIC PHASE 1. VOLUME 2: ADVANCED ENERGY CONVERSION SYSTEMS. PART 3: DIRECT ENERGY CONVERSION CYCLES Final Report

J. C. Corman, R. B. Fleming, L. P. Harris, and R. V. Pohl Feb. 1976 142 p refs Sponsored in part by ERDA and NSF 3 Vol.

(Contract NAS3-19406)

(NASA-CR-134948-Vol-2-Pt-3; SRD-76-011-Vol-2-Pt-3) Avail: NTIS HC \$6.00 CSCL 10B

For abstract, see N76-23680.

N76-23683*# General Electric Co., Schenectady, N.Y.

ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), GENERAL ELECTRIC PHASE 1. VOLUME 3: ENERGY CONVERSION SUBSYSTEMS AND COMPONENTS. PART 1: BOTTOMING CYCLES AND MATERIALS OF CONSTRUCTION Final Report

R. P. Shah and H. D. Solomon Feb. 1976 86 p refs Sponsored in part by ERDA and NSF 3 Vol.

(Contract NAS3-19406)

(NASA-CR-134948-Vol-3-Pt-1; SRD-76-011-Vol-3-Pt-1) Avail: NTIS HC \$5.00 CSCL 10B

Energy conversion subsystems and components were evaluated in terms of advanced energy conversion systems. Results

of the bottoming cycles and materials of construction studies are presented and discussed. J.M.S.

N76-23684*# General Electric Co., Schenectady, N.Y.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), GENERAL ELECTRIC PHASE 1. VOLUME 3: ENERGY CONVERSION SUBSYSTEMS AND COMPONENTS. PART 2: PRIMARY HEAT INPUT SYSTEMS AND HEAT EXCHANGERS Final Report

J. C. Corman, J. H. Eskesen, A. S. Robertson, and R. D. Stewart
 Feb. 1976 206 p refs Sponsored in part by ERDA and NSF
 3 Vol.

(Contract NAS3-19406)

(NASA-CR-134948-Vol-3-Pt-2; SRD-76-011-Vol-3-Pt-2) Avail:
 NTIS HC \$7.75 CSCL 10B

Primary heat input systems and heat exchangers were evaluated for advanced energy conversion systems. Results are presented and discussed. J.M.S.

N76-23685*# General Electric Co., Schenectady, N.Y.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), GENERAL ELECTRIC PHASE 1. VOLUME 3: ENERGY CONVERSION SUBSYSTEMS AND COMPONENTS. PART 3: GASIFICATION, PROCESS FUELS, AND BALANCE OF PLANT Final Report

W. A. Boothe, J. C. Corman, G. G. Johnson, and T. A. V. Cassel
 Feb. 1976 174 p refs Sponsored in part by ERDA and NSF
 3 Vol.

(Contract NAS3-19406)

(NASA-CR-134948-Vol-3-Pt-3; SRD-76-011-Vol-3-Pt-3) Avail:
 NTIS HC \$6.75 CSCL 10B

Results are presented of an investigation of gasification and clean fuels from coal. Factors discussed include: coal and coal transportation costs; clean liquid and gas fuel process efficiencies and costs; and cost, performance, and environmental intrusion elements of the integrated low-Btu coal gasification system. Cost estimates for the balance-of-plant requirements associated with advanced energy conversion systems utilizing coal or coal-derived fuels are included. J.M.S.

N76-23691*# National Aeronautics and Space Administration,
 Lewis Research Center, Cleveland, Ohio.

NASA THERMIONIC CONVERSION PROGRAM

J. F. Morris and J. G. Lundholm (NASA, Washington) 1976
 6 p refs Proposed for presentation at Eleventh Intersoc. Energy
 Conversion Eng. Conf., State Line, Nev., 12-17 Sep. 1976
 (NASA-TM-X-73430; E-8778) Avail: NTIS HC \$3.50 CSCL
 10A

Current out-of-core emphases allow converter material and design freedoms previously prohibited by in-core nucleonic and geometric restrictions. As a result, potential improvements indicate possibilities for severalfold increases in efficiencies. The new TEC-ART program concentrated initially on low-work function collectors and interelectrode-loss reduction and revealed much in a short time. This new emission capability coupled with improved collectors that maintain performance with emitter-vapor deposit accumulations are requisites for efficient, enduring thermionic converters. Author

N76-23692*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 1: INTRODUCTION AND SUMMARY AND GENERAL ASSUMPTIONS Final Report

D. T. Beecher 12 Feb. 1976 225 p refs 12 Vol.
 (Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551)
 (NASA-CR-134941-Vol-1) Avail: NTIS HC \$7.75 CSCL 10B

Nine advanced energy conversion concepts using coal or coal-derived fuels are summarized. They are: (1) open-cycle gas turbines; (2) combined gas-steam turbine cycles; (3) closed-cycle gas turbines; (4) metal vapor Rankine topping; (5) open-cycle MHD; (6) closed-cycle MHD; (7) liquid-metal MHD; (8) advanced steam; and (9) fuel cell systems. The economics, natural resource requirements, and performance criteria for the nine concepts are discussed. Author

N76-23693*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 2: MATERIALS CONSIDERATIONS Final Report

D. E. Thomas 12 Feb. 1976 306 p refs 12 Vol.
 (Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551)
 (NASA-CR-134941-Vol-2; Rept-76-9E9-ECAS-Rlv.2-Vol-2)
 Avail: NTIS HC \$9.75 CSCL 10B

Extensive studies are presented which were carried out on materials behavior in nine advanced energy conversion systems employing coal and coal-derived fuels. The areas of materials behavior receiving particular attention in this regard are: (1) fireside corrosion and erosion in boiler and heat exchanger materials; (2) oxidation and hot corrosion of gas turbine materials; (3) liquid metal corrosion and mass transport; (4) high temperature steam corrosion; (5) compatibility of materials with coal slag and MHD seed; (6) reaction of materials with impure helium; (7) allowable stresses for boiler and heat exchanger materials; (8) environmental effects on mechanical properties; and (9) liquid metal purity control and instrumentation. Such information was then utilized in recommending materials for use in the critical components of the power systems, and at the same time to identify materials problem areas and to evaluate qualitatively the difficulty of solving those problems. Specific materials recommendations for critical components of the nine advanced systems under study are contained in summary tables. Author

N76-23694*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 3: COMBUSTORS, FURNACES AND LOW-BTU GASIFIERS Final Report

J. R. Hamm 12 Feb. 1976 521 p refs 12 Vol.
 (Contracts NAS3-19407; E(49-18)-1751; NSF AG-551)
 (NASA-CR-134941-Vol-3; Rept-76-9E9-ECAS-Rlv.3-Vol-3)
 Avail: NTIS HC \$12.75 CSCL 10B

Information is presented on the design, performance, operating characteristics, cost, and development status of coal preparation equipment, combustion equipment, furnaces, low-Btu gasification processes, low-temperature carbonization processes, desulfurization processes, and pollution particulate removal equipment. The information was compiled for use by the various cycle concept leaders in determining the performance, capital costs, energy costs, and natural resource requirements of each of their system configurations. Author

N76-23695*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 4: OPEN RECUPERATED AND BOTTOMED GAS TURBINE CYCLES Final Report

D. J. Amos and J. E. Grube 12 Feb. 1976 117 p refs 12 Vol.
 (Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551)
 (NASA-CR-134941-Vol-4; Rept-76-9E9-ECAS-Rlv.4-Vol-4)
 Avail: NTIS HC \$5.50 CSCL 10B

Open-cycle recuperated gas turbine plant with inlet temperatures of 1255 to 1644 K (1800 to 2500 F) and recuperators with effectiveness values of 0, 70, 80 and 90% are considered. A 1644 K (2500 F) gas turbine would have a 33.5% plant efficiency in a simple cycle, 37.6% in a recuperated cycle and 47.6% when combined with a sulfur dioxide bottomer. The distillate burning recuperated plant was calculated to produce electricity at a cost of 8.19 mills/MJ (29.5 mills/kWh). Due to their low capital cost \$170 to 200 \$/kW, the open cycle gas turbine plant should see duty for peaking and intermediate load duty. Author

N76-23696*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 5: COMBINED GAS-STEAM TURBINE CYCLES Final Report

D. J. Amos, R. W. Foster-Pegg, and R. M. Lee 12 Feb. 1976 114 p refs 2 Vol.
 (Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551)
 (NASA-CR-134941-Vol-5; Rept-76-9E9-ECAS-Rlv.5 Vol-5)
 Avail: NTIS HC \$5.50 CSCL 10B

The energy conversion efficiency of gas-steam turbine cycles was investigated for selected combined cycle power plants. Results indicate that it is possible for combined cycle gas-steam turbine power plants to have efficiencies several point higher than conventional steam plants. Induction of low pressure steam into the steam turbine is shown to improve the plant efficiency. Post firing of the boiler of a high temperature combined cycle plant is found to increase net power but to worsen efficiency. A gas turbine pressure ratio of 12 to 1 was found to be close to optimum at all gas turbine inlet temperatures that were studied. The coal using combined cycle plant with an integrated low-Btu gasifier was calculated to have a plant efficiency of 43.6%, a capitalization of \$497/kW, and a cost of electricity of 6.75 mills/MJ (24.3 mills/kWh). This combined cycle plant should be considered for base load power generation. Author

N76-23697*# Westinghouse Research Labs., Pittsburgh, Pa. **ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 6: CLOSED-CYCLE GAS TURBINE SYSTEMS. Final Report**
D. J. Amos, W. K. Fentress, and W. F. Stahl 12 Feb. 1976 154 p refs 12 Vol.
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551) (NASA-CR-134941-Vol-6; Rept-76-9E9-ECAS-Riv.6-Vol-6) Avail: NTIS HC \$6.57 CSCL 10B

Both recuperated and bottomed closed cycle gas turbine systems in electric power plants were studied. All systems used a pressurizing gas turbine coupled with a pressurized furnace to heat the helium for the closed cycle gas turbine. Steam and organic vapors are used as Rankine bottoming fluids. Although plant efficiencies of over 40% are calculated for some plants, the resultant cost of electricity was found to be 8.75 mills/MJ (31.5 mills/kWh). These plants do not appear practical for coal or oil fired plants. Author

N76-23698*# Westinghouse Research Labs., Pittsburgh, Pa. **ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 7: METAL VAPOR RANKINE TOPPING-STEAM BOTTOMING CYCLES. Final Report**
P. B. Deegan 12 Feb. 1976 198 p. refs 12 Vol.
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551) (NASA-CR-134941-Vol-7; Rept-76-9E9-ECAS-Riv.7-Vol-7) Avail: NTIS HC \$7.50 CSCL 10B

Adding a metal vapor Rankine topper to a steam cycle was studied as a way to increase the mean temperature at which heat is added to the cycle to raise the efficiency of an electric power plant. Potassium and cesium topping fluids were considered. Pressurized fluidized bed or pressurized (with an integrated low-Btu gasifier) boilers were assumed. Included in the cycles was a pressurizing gas turbine with its associated recuperator, and a gas economizer and feedwater heater. One of the ternary systems studied shows plant efficiency of 42.3% with a plant capitalization of \$66.7/kW and a cost of electricity of 8.19 mills/MJ (29.5 mills/kWh). Author

N76-23699*# Westinghouse Research Labs., Pittsburgh, Pa. **ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 8: OPEN-CYCLE MHD. Final Report**
D. Q. Hoover 12 Feb. 1976 439 p. refs 12 Vol.
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551) (NASA-CR-134941-Vol-8; Rept-76-9E9-ECAS-Riv.8-Vol-8) Avail: NTIS HC \$11.75 CSCL 10B

Electric power plant costs and efficiencies are presented for three basic open-cycle MHD systems: (1) direct coal fired system, (2) a system with a separately fired air heater, and (3) a system burning low-Btu gas from an integrated gasifier. Power plant designs were developed corresponding to the basic cases with variation of major parameters for which major system components were sized and costed. Flow diagrams describing each design are presented. A discussion of the limitations of each design is made within the framework of the assumptions made. Author

N76-23700*# Westinghouse Research Labs., Pittsburgh, Pa. **ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 9: CLOSED-CYCLE MHD. Final Report**

T. C. Tsu 12 Feb. 1976 224 p refs 12 Vol.
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551) (NASA-CR-134941-Vol-9; Rept-76-9E9-ECAS-Riv.9-Vol-9) Avail: NTIS HC \$7.75 CSCL 10B

A closed-cycle MHD system for an electric power plant was studied. It consists of 3 interlocking loops, an external heating loop, a closed-cycle cesium seeded argon nonequilibrium ionization MHD loop, and a steam bottomer. A MHD duct maximum temperature of 2366 K (3800 F), a pressure of 0.939 MPa (9.27 atm) and a Mach number of 0.9 are found to give a topping cycle efficiency of 59.3%; however, when combined with an integrated gasifier and optimistic steam bottomer the coal to bus bar efficiency drops to 45.5%. A 1978 K (3100 F) cycle has an efficiency of 55.1% and a power plant efficiency of 42.2%. The high cost of the external heating loop components results in a cost of electricity of 21.41 mills/MJ (77.07 mills/kWh) for the high temperature system and 19.0 mills/MJ (68.5 mills/kWh) for the lower temperature system. It is, therefore, thought that this cycle may be more applicable to internally heated systems such as some futuristic high temperature gas cooled reactor. Author

N76-23701*# Westinghouse Research Labs., Pittsburgh, Pa. **ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 10: LIQUID-METAL MHD SYSTEMS. Final Report**

R. R. Holman and T. E. Lippert 12 Feb. 1976 200 p 12 Vol.
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551) (NASA-CR-134941-Vol-10; Rept-76-9E9-ECAS-Riv.10-Vol-10) Avail: NTIS HC \$7.50 CSCL 10B

Electric Power Plant costs and efficiencies are presented for two basic liquid-metal cycles corresponding to 922 and 1089 K (1200 and 1500 F) for a commercial applications using direct coal firing. Sixteen plant designs are considered for which major component equipment were sized and costed. The design basis for each major component is discussed. Also described is the overall systems computer model that was developed to analyze the thermodynamics of the various cycle configurations that were considered. Author

N76-23702*# Westinghouse Research Labs., Pittsburgh, Pa. **ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 11: ADVANCED STEAM SYSTEMS. Final Report**

R. W. Wolfe 12 Feb. 1976 315 p 12 Vol.
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551) (NASA-CR-134941-Vol-11; Rept-76-9E9-ECAS-Riv.11-Vol-11) Avail: NTIS HC \$9.75 CSCL 10B

A parametric analysis was made of three types of advanced steam power plants that use coal in order to have a comparison of the cost of electricity produced by them a wide range of primary performance variables. Increasing the temperature and pressure of the steam above current industry levels resulted in increased energy costs because the cost of capital increased more than the fuel cost decreased. While the three plant types produced comparable energy cost levels, the pressurized fluidized bed boiler plant produced the lowest energy cost by the small margin of 0.69 mills/MJ (2.5 mills/kWh). It is recommended that this plant be designed in greater detail to determine its cost and performance more accurately than was possible in a broad parametric study and to ascertain problem areas which will require development effort. Also considered are pollution control measures such as scrubbers and separates for particulate emissions from stack gases. Author

N76-23703*# Westinghouse Research Labs., Pittsburgh, Pa. **ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), WESTINGHOUSE PHASE 1. VOLUME 12: FUEL CELLS. Final Report**

C. J. Waide, R. J. Ruka, and A. O. Isenberg 12 Feb. 1976 191 p refs 12 Vol.

primitive societies in producing a residential option which is low in environmental impact as well as aesthetically attractive. An educational demonstration of this residential concept is to be developed on a six-acre plot twenty-five miles southwest of Chicago. The design and usage features are described which enable the occupants to collect all their residential energy from the sun, to receive all their water from natural rainfall, and to recycle their wastes for return to a horticultural plot which will provide most of their food. Adaptability of this concept to a variety of situations through modifications or abbreviations is considered. Author (ERA)

N76-23729# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.

TERRESTRIAL PHOTOVOLTAIC POWER SYSTEMS WITH SUNLIGHT CONCENTRATION Progress Report, 1 Jan. - 31 Jul. 1975

31 Jul. 1975 180 p refs Prepared jointly with Spectrolab, Inc., Sylmar, Calif.

(Contract E(11-1)-2590)

(COO-2590-1) Avail: NTIS HC \$12.00

Analytical modeling of silicon solar cells under high illumination was completed and it appears they can be designed to operate at over 100 suns with conventional processing and with characteristics comparable with conventional space cells. Cells are currently being fabricated which are optimized for various intensities for testing in a single cell concentrator simulator and for four system tests. Evaluation of various concentrator systems under actual weather conditions were completed for the 20 locations on the Aerospace data tapes. Even at the location of the lowest direct insolation (Omaha), several of the concentrator systems collected more energy than flat, fixed tilted arrays. Surface accuracy, off-axis tracking, and packing factor optimization analysis were started. System cost studies were extended to additional concentration systems and for comparisons of silicon and GaAs cells. Author (ERA)

N76-23730# Aerojet Nuclear Co., Idaho Falls, Idaho. National Engineering Lab.

REVIEW AND TENTATIVE SELECTION OF A WORKING FLUID FOR USE WITH A MEDIUM TEMPERATURE (300 F) GEOTHERMAL RESOURCE

J. F. Whitbeck Jul. 1975 19 p refs

(Contract E(10-1)-1375)

(ANCR-1224) Avail: NTIS HC \$4.00

A review of conventional refrigerants was made to determine the best fluid to be used as the working fluid in an electrical power plant application where energy will be derived from a medium temperature geothermal heat source. Major considerations were operating pressures, operational flexibility, thermal efficiency, line sizes, and potential for best utilization of the geothermal heat source. Isobutane was selected as the best working fluid for a 300 F geothermal fluid application. Its acceptability for the lower temperatures indicated the general utility of this fluid for power plant applications over a significant temperature range. In an effort to obtain maximum utilization of the geothermal fluid, a dual boiling cycle was selected as the reference cycle for preliminary study and a basis for future comparative analysis. Author (ERA)

N76-23731# Aerojet Nuclear Co., Idaho Falls, Idaho.

GEOLOGICAL ASPECTS OF AN ASSESSMENT OF THE NATIONAL POTENTIAL FOR NON-ELECTRICAL UTILIZATION OF GEOTHERMAL RESOURCES

K. M. Hollenbaugh and C. R. Nichols Jun. 1975 251 p refs (Contract AT(10-1)-1505)

(ANCR-1213) Avail: NTIS HC \$7.60

Data are presented on the potential sources and uses of geothermal water particularly in the Western third of the United States. These data include the currently known or expected location, quality, quantity, and temperatures of geothermal sources. Recommendations are made relative to potential utilization of these sources. In addition, suggestions are presented for the scientific evaluation of these and other potential geothermal sources. Author (ERA)

N76-23732# American Astronautical Society, Tarzana, Calif. **TEMPERATURE CONTROL FOR SOLAR HEATING AND COOLING OF BUILDINGS**

C. B. Winn and D. Hull 1975 36 p refs Presented at the 66th Ann. Conf. of Intern. District Heating Assoc., Skytop, Pa., 23 Jun. 1975 Sponsored in part by ERDA and NSF (AAS-75-105; Conf-750739-1) Avail: NTIS HC \$5.00

A control system presently being employed in existing solar energy buildings is presented. This controller is then discussed in terms of the development of control systems that allow the user to regulate the amount of solar and auxiliary supplied energy in the thermal control of buildings, the development of control systems that respond to variations in the use patterns of buildings on seasonal, daily, hourly, and instantaneous bases, and the development of controls based on algorithms that minimize the total use of energy in heating and cooling buildings. Several heuristic control strategies are considered and examined in terms of their performance. Finally, a discussion of optimal control strategies is presented and compared with the controllers previously examined. Author (ERA)

N76-23733# Argonne National Lab., Ill.

REGIONAL ENERGY MODELING: AN EVALUATION OF ALTERNATIVE APPROACHES

A. S. Cohen and K. W. Costello Jun. 1975 148 p refs Sponsored by ERDA

(ANL/AA-1) Avail: NTIS HC \$5.45

Eight comprehensive energy models, representing the current state of the art, are evaluated and their ability to analyze present energy issues is discussed. Initially, the criteria on which the evaluations are based are defined and, in the process, a conceptual model that contains the essential characteristics of a regional energy model is generated. Each of the models is evaluated individually and the modeling techniques used are compared. The models are categorized into local impact and national synthesis groups. The impact group can be applied to state or substate areas. Their forte is the degree of the end-use detail they provide. The national synthesis models are designed to analyze the impacts of national policies on the availability and/or consumption of energy on a national or regional basis. Recommendations for future research and model development are presented. The primary goal of these future research efforts is to alleviate the shortcomings of existing techniques. Author (ERA)

N76-23734# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

PERSPECTIVES IN ENERGY REQUIREMENTS OF MANKIND

J. L. Symonds Aug. 1975 34 p refs

(AAEC/IP-2) Avail: ERDA Depository Libraries HC \$4.75

The growth of energy demand from the nineteenth century to the present and its likely future development are described, for the interested layman, in the context of the changing pattern of resource use. The availability and distribution of the renewable and nonrenewable resources of energy, which will provide for the future, show that developed and developing countries will incur supply problems in the decades ahead unless the potential of all energy reserves is tapped. Factors such as the market penetration of new resources and the depletion of resources are outlined. It is pointed out that coal may be used increasingly for some time, but nuclear energy is the only other energy form that is immediately available and that can be utilized commercially. Nuclear energy will be needed even if countries are prepared to cut back to low growth rates in energy use. It is suggested that lower growth rates may well be necessary in the next twenty to thirty years, since it takes this time to bring new alternative technologies into commercial use, and a further similar period will be required to achieve significant resource substitution. Author (ERA)

N76-23735# Brookhaven National Lab., Upton, N.Y.

METHODOLOGY OF TECHNOLOGY ANALYSIS WITH APPLICATION TO ENERGY ASSESSMENT

K. C. Hoffman 1975 25 p refs Presented at the Ann. Meeting of ASME, Houston, Tex., 30 Nov. 1975

(BNL-20083; Conf-751106-12) Avail: NTIS HC \$4.25

In view of the significant social and economic consequences of technical change, it is important for the engineering community to provide sound technical inputs to the formulation of national policies. A methodology designed specifically for this purpose for application to large-scale technical systems is described and illustrated by application to the U. S. energy system. This methodology, Technology Analysis, uses three basic building blocks: a structural description of the system, and optimization technique for system synthesis and design, and a model of the economy within which technical detail and social structure may be expressed. The approach is general and is adaptable to other important technology policy areas including materials, agriculture, and transportation. Author (ERA)

N76-23736# Energy Research and Development Administration, Washington, D.C. Div. of Geothermal Energy.

DEFINITION REPORT: GEOTHERMAL ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION PROGRAM

Oct. 1975 76 p refs

(ERDA-86) Avail: NTIS HC \$5.45

A broad definition of Geothermal Energy RD and D Program involving the activities of ERDA and other cognizant Federal agencies is given. The goal of this program is to work with industry to provide the nation with an acceptable option which, if exercised, would permit the timely exploitation of our geothermal resources. Federal efforts which will assist industry in accelerating geothermal development are defined in the areas of resource assessment; research, development and demonstration in areas of high technical risk; information dissemination and loan guaranties to reduce financial risk; and assistance in the reduction and removal of institutional impediments to healthy industrial growth. Program planning for this Geothermal Energy Research, Development and Demonstration (RD and D) Program was carried out as a coordinated interagency effort and within the overall framework of the National Plan for Energy RD and D. ERA

N76-23737# Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.

ENERGY MODELS FOR ENVIRONMENT, POWER, AND SOCIETY

H. T. Odum and C. Kuystra 1975 376 p refs

(Contract AT(40-1)-4398)

(ORO-4398-3) Avail: NTIS HC \$11.75

This is an annual report and also a general contract summary of work on the energy models, concepts, and simulations for understanding the systems of environment, power, and society. Included is a general narrative of project work, summary of development of energy language and application of its models, simulation of systems of city and county size, development of net energy and energy quality theory, use of models and net energy theory to evaluate aspects of national policy, and aspects of interface between project work and national and state policy makers. Results this year include modeling and simulation of energy basis for Miami, Florida; net energy of coal, oil shale, solar water heating, and present nuclear power plants; and papers written on the theories of energy quality, energy theory of value, and investment ratio for estimating economic viability. A separate abstract was prepared for each of ten major sections. ERA

N76-23739# Oak Ridge National Lab., Tenn.

ELECTRICITY DEMAND BY MANUFACTURING INDUSTRIES IN THE UNITED STATES

W. S. Chern Nov. 1975 74 p refs

(Contract W-7405-eng-26)

(ORNL-NSF-EP-87) Avail: NTIS HC \$5.45

The important trends are examined related to the manufacturing consumption of electricity and to estimating the demand relationships for groups of and selected individual manufacturing industries. Emphasis is on the estimation of price response, interfuel substitution, and the impact of technological change. Sixteen major manufacturing industries at the Standard Industrial Classification three-digit level were selected for analysis. It is shown that industrial demand for electricity is price elastic in the long run. Furthermore, natural gas, oil, and coal were found

to be significant substitutes for electricity. However, the pattern of the interfuel substitution varies from industry to industry. The results also show that technological progress has reduced the manufacturing usage of electricity at an annual rate of 1.2%, while ignoring other factors over 1958-1971. Author (ERA)

N76-23740# Oak Ridge National Lab., Tenn.

ELECTRICITY DEMAND: PROJECT INDEPENDENCE AND THE CLEAN AIR ACT

L. D. Chapman, G. G. Akland, J. F. Finklea, R. I. Larsen, T. D. Mount, W. C. Nelson, D. C. Quigley, and W. C. Wilson Nov. 1975 69 p refs

(Contract W-7405-eng-26)

(ORNL-NSF-EP-89) Avail: NTIS HC \$5.45

Policy issues facing electric utilities, consumers, and Federal and state agencies were analyzed. Conclusions are: (1) Demand growth should proceed at a lesser rate than in the past. The 1980 consumption may be 2.2 trillion kWh, rather than the 3.1 trillion kWh projected by the Natural Electric Reliability Councils. (2) Conservation programs should be continued and expanded, and applied to every jurisdiction level and consumer group. (3) Natural gas use should be promoted for home and business heating where possible. Natural gas use in power generation and (in general) in industrial boilers is less desirable. The expansion of home and office electric resistance heating should be discouraged. (4) Rate structures should not be inverted, but rate increases should be passed along to consumers to reduce average price differences within classes and between classes. (5) The primary ambient air quality standards in the Clean Air Act should be implemented. Author (ERA)

N76-23741# Sandia Labs., Albuquerque, N.Mex.

LOW COST SOLAR AUGMENTED HEAT PUMP SYSTEM FOR RESIDENTIAL HEATING AND COOLING

J. M. Alcone 1975 28 p refs Presented at the Ann. Meeting

of ASME, Houston

(SAND-75-5272; Conf-751106-11) Avail: NTIS HC \$4.50

The analysis and design of a low cost solar collector/heat storage system configured to take advantage of the characteristics of conventional air-to-air heat pumps is presented. The dynamical interaction of the various system components is examined and the resulting design constraints are given. The system as proposed eliminates the collector costs associated with conventional solar systems while requiring an increase in the volume required for thermal storage of 50 percent. Author (ERA)

N76-23742# Institute for Water Resources, Fort Belvoir, Va. **HYDROELECTRIC POWER POTENTIAL AT CORPS OF ENGINEERS PROJECTS Final report**

Ralph L. Trisko, Amichai Gilead, G. P. Johnson, and Brion Sasaki Jul. 1975 345 p refs

(AD-A018359; IWR-RR-75-R1) Avail: NTIS CSCL 10/2

This study is intended as a broad framework within which the Corps of Engineers might conduct detailed studies at the project level of hydropower potential at Corps projects and on streams susceptible of development by the Corps. It assembles and analyzes data on U. S. undeveloped hydropower potential; fossil fuel and other energy resources and consumption, costs of electricity generation; Federal hydropower policy, organization, and marketing; Federal project evaluation; economic and environmental considerations; and potential fossil fuel conservation. GRA

N76-23743# Research Triangle Inst., Research Triangle Park, N.C.

RANN UTILIZATION EXPERIENCE. CASE STUDY NO. 19: SOLVENT-REFINED COAL

Z. L. Taylor 1975 22 p Prepared in cooperation with Auburn Univ.

(Contract NSF C-927)

(PB-247262/9; NSF/RA/G-75-047) Avail: NTIS HC \$3.50

Also included in complete report and summary as PB-247243; HC \$13.00 CSCL 21D

Coal, America's most abundant and available natural fuel source, can contribute significantly to supplying the nation's

increasing demand for fuels if improved extraction and refining technologies can be developed that meet anti-pollution requirements. This project investigated one process for coal gasification and liquefaction. The primary product of the solvent-refined coal (SRC) process is a solid fuel from which the impurities and inflammable materials have been removed. The report briefly reviews use of the research results. GRA

N76-23744# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE. A SUMMARY
Nov. 1974 115 p
(PB-248491/3; FEA/N-74/531) Avail: NTIS HC \$5.50 CSCI 05C

The Nation's energy problem is evaluated. The broad strategic options available to the U.S. are considered along with strategies in terms of their impact on: development of alternative energy sources; vulnerability to import disruptions; economic growth, inflation and unemployment; environmental effects; regional and social impacts. An analytical and factual basis for focusing debate on the difficult choices and tradeoffs, and selecting a national energy policy is provided. GRA

N76-23745# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE REPORT
Nov. 1974 788 p
(PB-248492/1; FEA/N-74/532) Avail: NTIS HC \$18.75 CSCI 10A

The base case situation through 1985 is assessed if current policies prevail; and the impacts and implications are evaluated of a wide range of major energy policy alternatives which should be considered as ways to eliminate imports. Policy alternatives are weighed in terms of vulnerability to supply disruptions, economic and social impacts, environmental effects, and regional differences. The broad strategic options available to the U.S. are compared. These include increasing domestic supply, conserving and managing energy demand, and establishing standby emergency programs. GRA

N76-23746# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. ANALYSIS OF REQUIREMENTS AND CONSTRAINTS ON THE TRANSPORT OF ENERGY MATERIALS. VOLUME 1 Final Report
Nov. 1974 389 p
(PB-248493/9; FEA/N-74/533-Vol-1) Avail: NTIS HC \$10.75 CSCI 21D

The degree to which transportation may be a constraint on the attainment of the goals of Project Independence and the effectiveness of various governmental policies in lifting any constraints are considered. The development of new energy sources and the change in the manner of use of old energy sources that must take place in order to transport such materials as coal, gas, petroleum and products from the source to intermediate processing and thence to the end use consumer is analyzed. Four primary modes of transportation are considered: truck, rail, waterway and pipeline. GRA

N76-23747# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. AVAILABILITIES, REQUIREMENTS, AND CONSTRAINTS ON MATERIALS, EQUIPMENT, AND CONSTRUCTION Final Report
Nov. 1974 483 p
(PB-248496/2; FEA/N-74/534) Avail: NTIS HC \$12.50 CSCI 13C

This report identifies and measures gaps between available and required quantities of materials, equipment, and construction that might constrain specific levels of increased energy production in the United States. It covers the energy-production process from exploration through final distribution in useable form. Eight categories considered to pose potential problems are studied. These are steel, drilling rigs, steam turbines, walking draglines, oil country tubular goods, nuclear steam supply systems, casting and forgings, and alloying metals. GRA

N76-23748# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. ENERGY CONSERVATION IN THE MANUFACTURING SECTOR 1954 - 1990, VOLUME 3 Final Report
Nov. 1974 475 p refs
(PB-248495/4; FEA/N-74/536) Avail: NTIS HC \$12.00 CSCI 10A

The extent to which the manufacturing sector will economize in its use of scarce energy resources is estimated. Six industries are the primary focus of the report and include: paper and allied products; chemicals and allied products; stone, clay, glass, hydraulic cement, and glass containers; primary metals; and food and kindred products. GRA

N76-23749# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. FACILITIES Final Report
Nov. 1974 597 p
(PB-248498/8; FEA/N-74/537) Avail: NTIS HC \$13.75 CSCI 10A

Oil refineries, natural gas processing plants, deep-water port facilities, fossil fueled electric power generation plants, electric power transmission and distribution systems, and the potential for conversion of current or projected oil-fired electric generation plants to coal are discussed. The national capability for hydroelectric power generation is estimated to develop formulas which could be used to represent the national or regional cost of delivered electric power taking into account alternative mixes. Alternative electric power generation and transmission costs are assessed taking into account alternative fuel mixes and site locations involving either greater transport of raw fuel or greater transmission of electric power. GRA

N76-23750# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. FINANCE: FINANCING PROJECT INDEPENDENCE, FINANCING REQUIREMENTS OF THE ENERGY INDUSTRIES, AND CAPITAL NEEDS AND POLICY CHOICES IN THE ENERGY INDUSTRIES Final Report
Nov. 1974 306 p
(PB-248499/6; FEA/N-74/538) Avail: NTIS HC \$9.75 CSCI 05C

The nation's financial capacity to support Project Independence and the impact of the anticipated energy investments upon financial markets are analyzed. The 1975-90 external financing requirements of the principal energy-producing industries as implied by the investment and income projections for specific fuels, based on inputs available as of September 12, 1974 are examined. Estimates of capital investments required for new productive capacity by the energy industries from 1974 to 1990 are summarized. GRA

N76-23751# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. GEOTHERMAL ENERGY Final Report
Nov. 1974 125 p
(PB-248500/1; FEA/N-74/539) Avail: NTIS HC \$5.50 CSCI 08G

The potential production capabilities of the geothermal industry and the resources necessary to achieve these levels of production are analyzed. Resources exploration and assessment, environmental, legal and institutional research, resource utilization projects, and advanced research and technology efforts are considered. The analysis considers constraints inhibiting rapid and widespread utilization of geothermal energy, such as technological, environmental, regulatory and legal, resource and institutional constraints; and discusses accelerated supply projections. GRA

N76-23752# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. AN HISTORICAL PERSPECTIVE Final Report
Nov. 1974 51 p
(PB-248501/9; FEA/N-74/540) Avail: NTIS HC \$4.50 CSCI 10A

An historical perspective to the Project Independence Blueprint is presented that traces the history of the various major energy sources and examines the reserves, consumption, technology, economics, and government policy towards oil, coal, natural gas, nuclear energy, electric power, and energy sources. The first two sections, Historical Perspective of World Energy and U.S. Energy Perspective, deal with major trends and events influencing all energy sources. Emphasis is on the period from the end of World War II to the eve of the Arab oil embargo. Government policies which have shaped the development of energy production and consumption are stressed. GRA

N76-23753# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. INPUTS TO THE PROJECT INDEPENDENCE EVALUATION SYSTEM INTEGRATION MODEL FOR THE TRANSPORT OF ENERGY MATERIALS. VOLUME 2 Final Report

Nov. 1974 228 p
 (PB-248494/7; FEA/N-74/541) Avail: NTIS HC \$8.00 CSCL 21D

Various methods of transporting energy materials are examined. Specific topics addressed include: transportation of coal by rail; coal transport via waterways; transport of oil and gas by pipeline; inland and coastal transport of petroleum; and the methodology used in developing coal slurry pipeline data. Resource requirements, cost estimates, and environment effects are considered. Author

N76-23754# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. LABOR REPORT Final Report

Nov. 1974 194 p refs
 (PB-248502/7; FEA/N-74/542) Avail: NTIS HC \$7.50 CSCL 05A

The report analyzes the future supply of labor with specific occupational skills and compares the availability to labor requirements for increased energy production. The results of the study were used, along with other analyses, to develop the Project Independence Blueprint. The report contains four major sections: an introduction; labor in the energy sector 1960-73; labor requirements for Project Independence; and labor policy alternatives. GRA

N76-23755# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. NATURAL GAS Final Report

Nov. 1974 242 p
 (PB-248503/5; FEA/N-74/543) Avail: NTIS HC \$8.00 CSCL 10A

The final technical analysis is reported of the Project Independence Interagency Natural Gas Task Force chaired by the Federal Power Commission. The task force was formed in April 1974 to provide estimates of the potential production capabilities of the natural gas industry and the resources necessary to achieve these levels of production. The task force evaluated two alternative strategies. The first was business-as-usual, which assumed the continuation of all current policies that could affect levels of production. The second strategy, accelerated demand, assumed selected changes in policies or practices that would permit a greater expansion of potential production. The report considers what could occur with respect to nonassociated natural gas from domestic sources during the period 1974 through 1990. Estimates were based on the following data: production data, price and cost data, and resource input data. Also considered in respect to increased natural gas production were environmental considerations and impacts and production constraints. GRA

N76-23756# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. NUCLEAR ENERGY Final Report

Nov. 1974 477 p
 (PB-248504/3; FEA/N-74/544) Avail: NTIS HC \$12.50 CSCL 10A

The final technical analysis is presented of the Project Independence Interagency Nuclear Task Force chaired by the Atomic Energy Commission. The task force was formed to provide estimates for the Project Independence Blueprint of the potential production capabilities of the nuclear industry and the resources necessary to achieve these levels of production. The task force evaluated several alternative strategies which assumed various levels of potential production. Topical discussions of the major resources required to achieve the projected production levels as well as subjects associated with nuclear power generation are discussed. GRA

N76-23757# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. OIL: POSSIBLE LEVELS OF FUTURE PRODUCTION Final Report

Nov. 1974 169 p refs
 (PB-248505/0; FEA/N-74/545) Avail: NTIS HC \$6.75 CSCL 08I

Estimates are presented to provide for the potential production capabilities of the oil industry and the resources necessary to achieve these levels of production. The possible levels of future production of petroleum liquids from domestic sources are outlined and how much domestic production would result at various price levels under a continuation of pre-1973 policies and, alternatively, under policies modified to give maximum encouragement to domestic oil production is estimated. Requirements for capital, equipment, materials, and personnel are also estimated. GRA

N76-23758# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. POTENTIAL FUTURE ROLE OF OIL SHALE. PROSPECTS AND CONSTRAINTS Final Report

Nov. 1974 834 p
 (PB-248506/8; FEA/N-74/546) Avail: NTIS HC \$21.25 CSCL 08I

The prospects are examined for expanding shale oil production to meet the objectives of Project Independence. Production potential; resource requirements such as human, money, and material resources; production constraints; and actions needed to accelerate development are considered. Economic factors in increased development of oil shale production; oil shale resource base and ownership; leasing requirements and policy; water demand, supply and quality; air quality analysis, impact on fish and wildlife, and the status of technology are discussed. GRA

N76-23759# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. PROJECT INDEPENDENCE AND ENERGY CONSERVATION. TRANSPORTATION SECTORS. VOLUME 2 Final Report

Nov. 1974 262 p
 (PB-248509/2; FEA/N-74/547) Avail: NTIS HC \$9.00 CSCL 21D

The impact of increased fuel prices on fuel consumption and the potential for energy conservation in transportation in the U.S. in the years 1980, 1985 and 1990 were investigated. All passenger and freight transportation is included in the study. The report contains five parts plus a summary. The introduction sets forth the key economic and policy assumptions of the study. Part 2 presents the data, analysis and projections for the passenger modes. Part 3 does the same for the freight modes. Part 4 includes a regional breakdown of the consumption of several key fuels. Part 5 analyzes the implications of price changes in crude oil and petroleum products on the demand for freight transportation. The summary provides an overview of the total study and presents summary data on transportation and energy consumption. GRA

N76-23760# Federal Energy Administration, Washington, D.C.
PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. SOLAR ENERGY Final Report

Nov. 1974 565 p

(PB-248507/6; FEA/N-75/548) Avail: NTIS HC \$13.50 CSCL 10A

The widespread, domestic, long-term, reliable availability of solar energy resources, and the general environmental acceptability of solar energy power systems is considered. The types of solar energy research, technology development, and system implementation needed to help meet the objectives of Project Independence are outlined. It is concluded that economically viable solar energy conversion systems can be developed and installed in substantial numbers well before the year 2000 to provide significant quantities of energy and power for the U.S. Six technically feasible solar energy technologies are described for heating and cooling buildings, providing high temperature heat, and producing electric power or clean fuels. GRA

N76-23761# Federal Energy Administration, Washington, D.C. **PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. RESIDENTIAL AND COMMERCIAL ENERGY USE PATTERNS 1970 - 1990, VOLUME 1 Final Report** Nov. 1974 305 p refs (PB-248508/4; FEA/N-74/549) Avail: NTIS HC \$9.75 CSCL 10A

The foundation is established for energy policy in the residential and commercial sectors of the economy. The present levels of consumption in the two sectors, the projected growth of this consumption under several energy price assumptions, and the potential for reducing this growth by various means are explained in detail. Some of the findings include the following: of the energy consumed at present in the combined sectors, 75 percent is attributable to residential use and 70 percent is used for space heating; the projected growth at high levels of energy consumption in the combined sectors is at the rate of 2.3 percent per year. GRA

N76-23762# Federal Energy Administration, Washington, D.C. **PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. SYNTHETIC FUELS FROM COAL Final Report** Nov. 1974 358 p (PB-248510/0; FEA/N-74/550) Avail: NTIS HC \$10.50 CSCL 21D

Estimates are given of the potential production capabilities of the synthetic fuels industry and the resources necessary to achieve these levels of production. An additional section on the impact of plant operations discusses environment, nature and source of pollutants from coal conversion process, operating personnel safety and health, social impact anticipated from the urbanization of rural areas, the political impact of plant operations, local economic impact of plant construction and operation, and the financial impact of plant operation. Technological aspects of the coal conversion process and an economic analysis of unit product costs are described. GRA

N76-23763# Federal Energy Administration, Washington, D.C. **PROJECT INDEPENDENCE BLUEPRINT. TASK FORCE REPORT. WATER REQUIREMENTS, AVAILABILITIES, CONSTRAINTS, AND RECOMMENDED FEDERAL ACTIONS Final Report** Nov. 1974 130 p (PB-248511/8; FEA/N-74/564) Avail: NTIS HC \$6.00 CSCL 10A

The degree to which the water resources of the United States will be able to accommodate increases in energy production is examined. Factors considered include: the competition of energy-related water requirements with existing or anticipated future water uses; accommodation of energy-related water requirements with other competing uses; the magnitude of any water supply shortages, water quality, institutional and other water supply problems on future energy development scenarios; water-related federal actions required to overcome problems, requirements placed on hydroelectric power generation capability to assist in meeting the nation's energy needs. GRA

N76-23765*# New Mexico Univ., Albuquerque. Technology Application Center. **WIND ENERGY UTILIZATION, A BIBLIOGRAPHY WITH**

ABSTRACTS. CUMULATIVE VOLUME, 1944/1974

Apr. 1975 491 p Sponsored by NASA, ERDA and NSF (NASA-CR-147342; PB-247970/7; TAC-W-75-700; NSF/RA/N-75-061) Copyright. Avail: NTIS HC \$10.00/MF \$10.00 for foreign requestors only. Domestic orders, Univ. of New Mexico, Tech. Application Center, Albuquerque CSCL 10B

An energy information base which covers the broad spectrum of the energy field was developed. Wind information from throughout the world was retrieved and evaluated to compile this bibliography. The bibliography substantiates that much of wind research, as it relates to energy considerations, was accomplished early in this century, and that much research is yet to be done. GRA

N76-23999*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ALTERNATIVE APPROACHES TO FUSION

Reece J. Roth 1976 54 p refs Presented at course on controlled fusion, Austin, Tex., 26-28 May 1976; sponsored by IEEE Nucl. and Plasma Sci. Soc. (NASA-TM-X-73429) Avail: NTIS HC \$4.50 CSCL 20I

The limitations of the Tokamak fusion reactor concept are discussed and various other fusion reactor concepts are considered that employ the containment of thermonuclear plasmas by magnetic fields (i.e., stellarators). Progress made in the containment of plasmas in toroidal devices is reported. Reactor design concepts are illustrated. The possibility of using fusion reactors as a power source in interplanetary space travel and electric power plants is briefly examined. J.R.T.

N76-24066# Committee on Interior and Insular Affairs (U. S. Senate).

FEDERAL COAL LEASING AMENDMENTS ACT OF 1975

Washington GPO 1975 682 p refs Hearings on S. 391 before Subcomm. on Minerals, Materials and Fuels of Comm. on Interior and Insular Affairs, 94th Congr., 1st Sess., 7-8 May 1975

(GPO-53-918) Avail: Subcomm. on Minerals, Materials and Fuels

Hearings held before the subcommittee on minerals, materials and fuels of the Committee on Interior and Insular Affairs of the U.S. Senate on the Federal Coal Leasing Amendments Act of 1975 were reported. The proposed bill (S.391) would make six basic changes in the Mineral Leasing Act of 1920: (1) coal leases would be issued by competitive bidding only, (2) leases would be issued after adoption of comprehensive land use plans, (3) prospecting permits and preference right leases would be eliminated, (4) coal leases would be for a specified term of 20 years and so long thereafter as coal is produced in paying quantities, (5) lessees would have to submit development and reclamation plans one year after obtaining a coal lease, and (6) the revenue-sharing provision of the Mineral Leasing Act of 1920 would be amended to broaden the purposes for which the States can use their share of coal-leasing revenues. Y.J.A.

N76-24067# Committee on Interior and Insular Affairs (U. S. Senate).

OUTER CONTINENTAL SHELF LANDS ACT AMENDMENTS AND COASTAL ZONE MANAGEMENT ACT AMENDMENTS, PART 1

Washington GPO 1975 700 p refs Joint Hearings pursuant to S. Res. 45 and S. Res. 222 before Comm. on Interior and Insular Affairs and Comm. on Commerce, 94th Congr., 1st Sess., 14, 17-18 Mar. 1975

(GPO-49-982) Avail: Comm. on Interior and Insular Affairs

Bills dealing with Federal outer continental shelf oil and gas development and its impact on the coastal zone are considered. Economic, social, and environmental effects, both on the ocean and its resources and onshore are examined. J.M.S.

N76-24068 Committee of Conference (U. S. Congress).

PETROLEUM PRICING REVIEW ACT

Washington GPO 1975 17 p Rept. to accompany H.R. 4035, 94th Congr., 1st Sess., 14 Jul. 1975 (H-Rept-94-356; GPO-57-006) Avail: US Capitol, House Document Room

This act provides for Congressional review and optional disapproval of proposals to remove price ceilings or to raise the price of domestic oil. An interim extension of certain energy authorities is also included. The text of the bill and an explanation of its contents are presented. D.M.L.

N76-24071# Committee on Science and Technology (U. S. House).

ERDA AUTHORIZATION. PART 6: 1976 AND TRANSITION PERIOD ENVIRONMENT AND SAFETY

Washington GPO 1975 843 p refs Hearings before Subcomm. on Energy Res., Development and Demonstration (fossil fuels) and the Subcomm. on Energy Res., Development and Demonstration of Comm. on Sci. and Technol., 94th Congr., 1st Sess., No. 4, 26 Feb. 1975 (GPO-54-199) Avail: Subcomm. on Energy Res., Development and Demonstration

The hearings are reported concerning the budget authorization for ERDA relating to environment and safety in the fossil fuel area. Topics discussed include: ERDA organization, operational safety, development of biomedical and environmental research budget, energy technologies, human research, coal and synthetic fuels, and gas and oils. F.O.S.

N76-24075*# Peat, Marwick, Mitchell and Co., Burlingame, Calif.

TECHNOLOGY ASSESSMENT OF FUTURE INTERCITY PASSENGER TRANSPORTATION SYSTEMS. VOLUME 1: SUMMARY REPORT

Mar. 1976 33 p refs Sponsored in part by DOT Prepared in cooperation with Calif. Univ., San Diego, Stanford Univ., Calif., Gellman Res. Assoc., Inc., Jenkintown, Pa., and Science Applications, Inc., Los Angeles 7 Vol. (Contract NAS2-8730)

(NASA-CR-137864) Avail: NTIS HC \$4.00 CSCL 13F

Technical, economic, environmental, and sociopolitical issues associated with future intercity transportation system options were assessed. Technology assessment was used as a tool to assist in the identification of basic research and technology development tasks that should be undertaken. The emphasis was on domestic passenger transportation, but interfaces with freight and international transportation were considered. Author

N76-24082*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

INITIAL COMPARISONS OF MODULAR-SIZED, INTEGRATED UTILITY SYSTEMS AND CONVENTIONAL SYSTEMS FOR SEVERAL BUILDING TYPES

Harold E. Benson and Leo G. Monford, Jr. Apr. 1976 90 p (NASA-TM-X-58140; JSC-09076) Avail: NTIS HC \$5.00

The results of a study of the application of a modular integrated utility system to six typical building types are compared with the application of a conventional utility system to the same facilities. The effects of varying the size and climatic location of the buildings and the size of the powerplants are presented. Construction details of the six building types (garden apartments, a high rise office building, high rise apartments, a shopping center, a high school, and a hospital) and typical site and floor plans are provided. The environmental effects, the unit size determination, and the market potential are discussed. The cost effectiveness of the various design options is not considered. Author

N76-24652# Los Alamos Scientific Lab., N.Mex. **SOLID EARTH GEOSCIENCES RESEARCH ACTIVITIES AT LASL, 1 JULY - 31 DECEMBER 1974**

T. R. McGetchin, comp. Jul. 1975 93 p refs (Contract W-7405-eng-36)

(LA-5956-PR) Avail: NTIS HC \$5.45

The present major efforts in energy related research are the dry hot rock geothermal energy project and the rock melting subterranean, an electrically powered, high temperature experimental

drilling technique. Research activities in support of geothermal energy include: (1) geochemical and petrological investigations of drill cores; (2) physical and mechanical properties of the cores, in situ and in the laboratory; (3) seismology; (4) experimental and numerical investigation of the chemical interaction of granite and hot aqueous solutions, and (5) field and laboratory investigations of heat flow and the thermal properties of the cores. ERA

N76-24682# Committee on the Judiciary (U. S. Senate).

OUTER CONTINENTAL SHELF OIL AND GAS DEVELOPMENT

Washington GPO 1975 303 p refs Joint Hearings before Subcomm. on Administrative Practice and Procedure of Comm. on the Judiciary and the Natl. Ocean Policy Study of Comm. on Commerce, 93d Congr., 2d Sess., 5 Aug., 7 Oct. 1974 (GPO-44-827) Avail: Subcomm. on Administrative Practice and Procedure

Testimony concerning the feasibility of leasing well sites on the outer continental shelf for oil and gas development is presented. Topics for discussion included economic and environmental considerations regarding proposed oil exploration off the Massachusetts coast. Presentations were made by representatives of government, the scientific community and lobbyists for environmental groups. A.S.K.

N76-24696* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

SOLAR ENERGY TRAP Patent

Lott W. Brantley, Jr., inventor (to NASA) Issued 25 May 1976 22 p Filed 29 Oct. 1974

(NASA-Case-MFS-22744-1; US-Patent-3,958,553;

US-Patent-Appl-SN-518544; US-Patent-Class-126-270;

US-Patent-Class-126-271; US-Patent-Class-350-293;

US-Patent-Class-350-299) Avail: US Patent Office CSCL 10A

An apparatus is described for trapping solar energy for heating a fluid that could be subsequently used in turbines and similar devices. The apparatus includes an elongated vertical light pipe having an open end through which the visible spectrum of electromagnetic radiation from the sun passes to strike a tubular absorber. The light pipe has a coated interior surface of a low absorptivity and a high reflectivity at the visible wavelengths and a high absorptivity/emissivity ratio at infrared wavelengths. The tubular absorber has a coating on the surface for absorbing visible wavelengths to heat the fluid passing through. Infrared wave lengths are radiated from the tubular absorber back into the light pipe for heating fluid passing through a tubular coil wound around it. Official Gazette of the U.S. Patent Office

N76-24697* New Mexico Univ., Albuquerque: Technology Application Center.

QUARTERLY LITERATURE REVIEW OF HYDROGEN ENERGY: A BIBLIOGRAPHY WITH ABSTRACTS, FOURTH QUARTER 1975 Quarterly Update

31 Dec. 1975 56 p Sponsored by NASA

(NASA-CR-147972) Copyright. Avail: NTIS for foreign requesters only. Domestic orders, Univ. of New Mexico, Tech. Application Center, Albuquerque CSCL 10B

This bibliography lists 337 reports, articles, and other documents introduced into the NASA scientific and technical information system from January 1, 1975 through March 31, 1975. Author

N76-24698 British Library Lending Div., Boston Spa (England). **LARGE NUCLEAR POWER STATIONS OF THE FUTURE AND ENVIRONMENTAL CONSTRAINTS**

M. Widmer et al [1975] 18 p Transl. into ENGLISH from French report Presented at 9th World Energy Conf., Detroit, 22-27 Sep. 1974

(BLL-CE-Trans-6684-(9022.09)) Avail: British Library Lending Div., Boston Spa, Engl.

The unit capacity of nuclear power stations can be expected to increase further in the future. The problem of the cooling supply is therefore of primary importance and is bound to affect the design of power stations, their thermodynamic cycles and

the generating plant. A solution is proposed which consists of using a binary water-ammonia cycle, with direct condensation of the ammonia in dry cooling towers. It is shown that this solution is feasible and solves the problems of thermal pollution and large output. It also gives much greater freedom in the choice of sites: reduction in transmission costs, possibility of siting stations in uninhabitable areas, etc. The study also considers the economic aspects and concludes that, as regards France and the medium-term nuclear future, this technique, by virtue of the freedom it provides with regard to the choice of sites, may lead to a satisfactory solution. Author

N76-24700# Committee on Interior and Insular Affairs (U. S. Senate).

GREATER COAL UTILIZATION, PART 1

Washington GPO 1975 795 p refs Joint Hearings on S. 1777 before Comm. on Interior and Insular Affairs and Comm. on Public Works, 94th Congr., 1st Sess., 10-11 Jun. 1975 (GPO-55-305) Avail: Comm. on Interior and Insular Affairs

Testimony concerning proposed legislation to require new industrial boilers and power plants to utilize coal as an energy source is presented. Statements of representatives from the coal industry, electric utilities, government, and the railroads are presented. Also included are environmental and economic impact reports and coal resource surveys. A.S.K.

N76-24701# Committee on Interior and Insular Affairs (U. S. Senate).

GREATER COAL UTILIZATION, PART 2

Washington GPO 1975 919 p refs Joint Hearings on S. 1777 before Comm. on Interior and Insular Affairs and Comm. on Public Works, 94th Congr., 1st Sess., 12, 16, and 23 Jun. 1975 (GPO-55-305) Avail: Comm. on Interior and Insular Affairs

Additional testimony concerning proposed legislation to require new industrial boilers and power plants to utilize coal as an energy source is presented. Statements of representatives from the coal industry, electric utilities, government, industry, and the railroads are presented. Also included are environmental and economic impact reports and coal resource surveys. A.S.K.

N76-24705# Select Committee on Small Business (U. S. House). **PHASE 4 OIL REGULATIONS AND PETROLEUM MARKETING PROBLEMS. PART 2: MANDATORY ALLOCATION AND DISTRIBUTION PROBLEMS**

Washington GPO 1974 256 p refs Hearings before Subcomm. on Activities of Regulatory Agencies of Permanent Select Comm. on Small Business, 93d Congr., 2d Sess., 19-21 Mar. 1974 (GPO-32-811) Avail: Subcomm. on Activities of Regulatory Agencies

Testimony concerning the effects of mandatory oil allocations on small businesses is presented. The government, the oil production industry, and gasoline retailers were represented. A.S.K.

N76-24709# Los Alamos Scientific Lab., N.Mex.

GEOTHERMAL ENERGY

J. W. Tester and S. L. Milora 1975 18 p refs Presented at the Energy Sources of the Future Meeting, Oak Ridge, Tenn. (Contract W-7405-eng-36)

(LA-UR-75-1463; Conf-750733-1) Avail: NTIS HC \$4.00

Six areas of geothermal resource utilization are discussed: (1) concept and potential of the resource; (2) natural geothermal systems; (3) artificially stimulated, dry hot rock geothermal systems; (4) energy utilization alternatives; (5) power cycle thermodynamics; and (6) power cycle economics. A summary is also given of the preliminary results from a joint study directed toward developing thermodynamic and economic design criteria applicable to geothermal electric power systems. ERA

N76-24710# Aerojet Nuclear Co., Idaho Falls, Idaho. Idaho National Engineering Lab.

FEASIBILITY REVIEW FOR GEOTHERMAL CONVERSION

OF EXISTING H AND V SYSTEMS ON THE BOISE GEOTHERMAL SPACE HEATING PROJECT

L. D. Torgerson and A. S. Richardson Sep. 1975 66 p

(Contract E(10-1)-1375)

(ANCR-1256) Avail: NTIS HC \$5.45

A pilot demonstration project to be located in the city of Boise, Idaho has been initiated to heat by geothermal water a number of public buildings. This report presents the findings of a study which was made to review the feasibility of converting the various public building heating systems to allow the use of geothermal water at a temperature of at least 170 F as a heat source. Author (ERA)

N76-24712# Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.

REVIEW OF PUMPED ENERGY STORAGE SCHEMES

G. N. Unsworth Jul. 1975 56 p refs

(AECL-4926) Avail: ERDA Depository Libraries HC \$5.50; Atomic Energy of Can. Ltd., Chalk River HC \$1.50

Pumped energy storage will become an attractive consideration for utilities as their installed nuclear generating capacity increases to the point that it exceeds the minimum power demand. A summary is given of energy storage systems that are available and might prove economically attractive. The advantages and disadvantages of each scheme and a comparative cost study are presented. The energy storage schemes considered are: pumped water storage; steam accumulators; storage of boiler feedwater (in caverns and above ground); and compressed air in caverns (for gas turbines). The results of cost analysis indicate that boiler feedwater storage in caverns and pumped water storage are competitive as the most economical scheme. Author (ERA)

N76-24713# Pennsylvania Dept. of Education, Harrisburg.

ENVIRONMENTAL IMPACT OF ELECTRICAL POWER GENERATION: NUCLEAR AND FOSSIL

1975 240 p refs

(Contract AT(40-2)-4167)

(ERDA-69) Avail: NTIS HC \$8.00

The increasing need for electrical power, and current and proposed methods for meeting this need are examined. Expansion of electrical generating capacity in the immediate future will be limited to nuclear power plants or fossil fueled plants. Basic ecology and wastes from nuclear and fossil fueled plants are discussed. Health effects are analyzed. The factors that must be taken into consideration when choosing the site for a new power plant are presented. Energy conservation and a summary of environmental effects are included. Author (ERA)

N76-24715# Washington Univ., Seattle. Dept. of Physics. **ENERGY CONTROVERSY: THE ROLE OF NUCLEAR POWER**

Fred H. Schmidt and D. Bogdansky Feb. 1975 101 p refs Sponsored in part by ERDA

(RLO-1388-296) Avail: NTIS HC \$6.50

Only nuclear fission, nuclear fusion, and solar energy can provide for future time scales commensurate with man's historic past, while avoiding the possibility of catastrophic social upheaval. Fusion and solar energy are rejected on technological grounds because the world energy problem is so pressing that one cannot gamble on hopes for future technological breakthroughs. Thus, only nuclear fission meets the twin criteria of technological feasibility and adequate resource base. Each of the controversial issues surrounding nuclear fission energy is examined in some detail. The conclusion is reached that none is serious, and that nuclear fission offers by far the best energy source from environmental, economic, longevity, and overall safety standpoints. Author (ERA)

N76-24717# Lockheed Missiles and Space Co., Sunnyvale, Calif. **OCEAN THERMAL ENERGY CONVERSION (OTEC) POWER PLANT TECHNICAL AND ECONOMIC FEASIBILITY. VOLUME 2: SUPPORTING DATA**

12 Apr. 1975 818 p refs Sponsored in part by ERDA and NSF Prepared in cooperation with Bechtel Corp., San Francisco and Lin (T. Y.) International, San Francisco (LMSC-0056566-Vol-2; NSF/RANN/SE/GI-C-937/FR-75-1-2) Avail: NTIS HC \$21.25

A 9-month study of the practicality of generating electrical power at competitive busbar prices by using the solar energy that is stored as a thermal gradient in the world's oceans was completed. This volume is a compendium of the most significant detailed data and engineering analyses developed during the course of this brief, but intensive, study of a complex problem. ERA

N76-24722# Organization for Industrial Research, TNO, The Hague (Netherlands).

HYDROGEN AS ENERGY CARRIER. FUTURE POSSIBILITIES IN THE NETHERLANDS. A SUMMARY [TOEKOMSTIGE MOGELIJKHEDEN VAN WATERSTOF ALS ENERGIEDRAGER IN NEDERLAND. BEKNOPT OVERZICHT]

Sep. 1975 41 p In DUTCH

Avail: NTIS HC \$4.00

The application of hydrogen as carrier for thermal energy, as discussed in the full report is summarized, with emphasis on production, storage, transport, and distribution of hydrogen, location bound utilization, application in transport vehicles, environment, and safety. ESA

N76-24723# Organization for Industrial Research, TNO, The Hague (Netherlands).

HYDROGEN AS ENERGY CARRIER. FUTURE POSSIBILITIES IN THE NETHERLANDS [WATERSTOF ALS ENERGIEDRAGER, TOEKOMSTIGE MOGELIJKHEDEN IN NEDERLAND]

Sep. 1975 281 p refs In DUTCH

Avail: NTIS HC \$9.25

The application of hydrogen as carrier for thermal energy, produced by new energy sources such as nuclear reactors and wind and solar energy generators, is discussed. Topics dealt with include production, storage, transport and distribution of hydrogen, aspects of location bound use, application in transport vehicles, environmental and safety aspects, and problems in introducing hydrogen. Conclusions and recommendations for each of these topics are given and, as a general conclusion, there are thought to be wide perspectives for the use of hydrogen as carrier in the energy supply in the Netherlands. The technological problems are considered surmountable. ESA

N76-24724# Staatliches Forschungsinstitut fuer Geochemie, Bamberg (West Germany).

INVESTIGATION OF ACID-RESISTANT ELECTROCATALYSTS FOR FUEL CELLS [UNTERSUCHUNGEN UEBER SAEURERESISTENTE ELEKTROKATALYSATOREN FUER BRENNSTOFFZELLEN]

H. U. Meier, U. Tschirwitz, E. Zimmerhackl, and W. Albrecht Bonn DOKZENTBw 1975 104 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung (BMVg-FBWT-75-6) Avail: NTIS HC \$5.50; DOKZENTBw DM 30.00

Methods used in the synthesis of electrocatalysts belonging to the class of polymeric metal-phthalocyanines and the procedure of testing electrocatalytic properties of these polymers are reported. Various properties of polymeric phthalocyanines (such as conductivity, catalase effect, and stability in acid) and the electrocatalytic activity for the reduction of oxygen obtained in sulfuric acid are described. A high-catalytic activity with respect to the oxygen reduction was obtained in 6 N H₂SO₄ with carbon-Teflon electrodes containing polymeric iron-phthalocyanine compounds. The current density was 20 to 80 mA/sq cm for a potential of 850 to 650 mV (standard hydrogen electrode) at room temperature. The potentials of the electrodes with polymeric phthalocyanine complexes of iron (and cobalt) as catalysts show only a relatively small decrease with time which is in the order of less than 100 mV at a load of 20 mA/sq cm during 1,000 hr. The high electrocatalytic activity of Fe-polyphthalocyanines is explained using a model. Author (ESA)

N76-24726# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Inst. fuer Chemische Raketenantriebe.

PRODUCTION AND UTILIZATION OF ALTERNATIVE SECONDARY ENERGY CARRIERS [ERZEUGUNG UND NUTZBARMACHUNG VON ALTERNATIVEN SEKUNDAER-ENERGIETRAEGERN]

J. Nitsch 24 Apr. 1975 34 p In GERMAN

(DLR-IB-456-75/5) Avail: NTIS HC \$4.00

Planned projects are outlined. Hydrogen, the most promising and most universal energy carriers, is used as an example. Primary activities considered are: investigation of combined thermochemical-electrolytical cycling processes, storage of hydrogen in low temperature absorbers and hydrogen-oxygen fed cycling process for energy storage and peak current generation. Supplementary activities are: the hydrogen aircraft, investigations of the liquid hydrogen tank/engine in an automobile, and safety investigations with hydrogen. Planned research in the fields of alcohols and mineral oil processing is mentioned. ESA

N76-24729# Mitre Corp., McLean, Va.

PROCEEDINGS OF QUANTITATIVE ENVIRONMENTAL COMPARISON OF COAL AND NUCLEAR ELECTRICAL GENERATION AND THEIR ASSOCIATED FUEL CYCLES WORKSHOP, VOLUME 1

Aug. 1975 357 p refs Workshop held in McLean, Va., 27-28 May 1975 2 Vol.

(Contract NSF C-925)

(PB-248649/6; MTR-7010-Vol-1; NSF/OEP-76-0001-Vol-1)

Avail: NTIS HC \$10.50 HC also available from NTIS \$21.00/set of 3 reports as PB-221906-SET CSDL 10B

A partial listing of topic areas includes: Application of decision analysis methodology to coal and nuclear fuel cycles; Social costs and risk of nuclear radiation accident; Social and economic costs of the nuclear and coal fuel cycles; Fossil fuel utilization, pollution, and climate modification risk; Diversion and sabotage; Issues concerning the safety and safeguards in the transportation of radioactive materials; Release mechanisms of fuel reprocessing plants; A risk comparison of recovery vs. reactor plants; The nature of nuclear wastes and the question of time perspectives. GRA

N76-24730# Mitre Corp., McLean, Va.

PROCEEDINGS OF QUANTITATIVE ENVIRONMENTAL COMPARISON OF COAL AND NUCLEAR ELECTRICAL GENERATION AND THEIR ASSOCIATED FUEL CYCLES WORKSHOP, VOLUME 2

Aug. 1975 207 p refs Workshop held in McLean, Va., 27-28 May 1975 2 Vol.

(Contract NSF C-925)

(PB-248650/4; MTR-7010-Vol-2; NSF/OEP-76-0002-Vol-2)

Avail: NTIS HC \$7.75 HC also available from NTIS \$21.00/set of 3 reports as PB-248648-SET CSDL 10B

This report contains the second day's edited transcripts of discussions and comments at a workshop on the Quantitative Environmental Comparison of Coal and Nuclear Electric Generation and Their Associated Fuel Cycles held at The MITRE Corporation in McLean, Virginia on May 27 and 28, 1975. The purpose of the workshop was to quantify the risks arising from the various elements of coal and nuclear fuel cycles and to assess the economic costs and environmental consequences associated with electric generation. GRA

N76-24731# Mitre Corp., McLean, Va.

QUANTITATIVE ENVIRONMENTAL COMPARISON OF COAL AND NUCLEAR GENERATION WORKSHOP, SUMMARY

R. Bernardi and B. Borko Sep. 1975 98 p refs Workshop held at McLean, Va., 27-28 May 1975 2 Vol.

(Contract NSF C-925)

(PB-248651/2; MTR-7004-Suppl; NSF/OEP-76-0003-Suppl)

Avail: NTIS HC \$5.00 HC also available from NTIS \$21.00/set of 3 reports as PB-248648-SET CSDL 10B

On May 27 and 28, 1975, The MITRE Corporation held a workshop addressing the quantitative environmental comparison

of coal and nuclear electrical generation. The agenda was planned to summarize the risks arising from the various elements of the coal and nuclear fuel cycles and to assess the economic and environmental consequences associated with electrical generation. This document summarizes the presentations, comments, and discussions at the workshop. GRA

N76-24732# Nuclear Regulatory Commission, Washington, D.C. Office of Special Studies.

NUCLEAR ENERGY CENTER SITE SURVEY, 1975. PART 1. SUMMARY AND CONCLUSIONS

Jan. 1976 231 p
(PB-248612/4; NUREG-0001-Pt-1) Avail: NTIS HC \$8.00
Also available in set of 7 reports as PB-248610-SET.
HC \$59.00 CSCL 18E

Clustering of sizable groups of nuclear facilities on a relatively small number of sites is examined. Three basic types of nuclear energy centers (NECs) are considered: power-plant centers (10 to 40 nuclear electric generating units of 1,200-MWe capacity each); fuel-cycle centers (fuel reprocessing plants, mixed-oxide fuel fabrication facilities, and radioactive waste management facilities); and combined (power and fuel-cycle) centers. The survey evaluates the feasibility and practicality of the NEC concept. The technical feasibility considerations include dissipation of waste heat, transmission, construction economics, and radiological and environmental impacts. GRA

N76-24733# Nuclear Regulatory Commission, Washington, D.C. Office of Special Studies.

NUCLEAR ENERGY CENTER SITE SURVEY, 1975. PART 2. THE US ELECTRIC POWER SYSTEM AND THE POTENTIAL ROLE OF NUCLEAR ENERGY CENTERS

Jan. 1976 231 p refs
(PB-248613/2; NUREG-0001-Pt-2) Avail: NTIS HC \$8.00
Also available in set of 7 reports as PB-248610-SET.
HC \$59.00 CSCL 18E

A perspective of the U.S. electric power system and the potential role of nuclear energy centers in the future evolution of the system are considered. GRA

N76-24734# Nuclear Regulatory Commission, Washington, D.C. Office of Special Studies.

NUCLEAR ENERGY CENTER SITE SURVEY, 1975. PART 3. TECHNICAL CONSIDERATIONS

Jan. 1976 635 p refs
(PB-248614/0; NUREG-0001-Pt-3) Avail: NTIS HC \$16.25
Also available in set of 7 reports as PB-248610-SET.
HC \$59.00 CSCL 18E

The technical considerations involved in determining whether or not the nuclear energy center concept is feasible are analyzed. Principal issues included are heat dissipation to the atmosphere, electric power transmission, facility and transmission unit costs, and radiological and environmental impact. GRA

N76-24735# Nuclear Regulatory Commission, Washington, D.C. Office of Special Studies.

NUCLEAR ENERGY CENTER SITE SURVEY, 1975. PART 4. PRACTICAL ISSUES OF IMPLEMENTATION

Jan. 1976 709 p
(PB-248615/7; NUREG-0001-Pt-4) Avail: NTIS HC \$18.75
Also available in set of 7 reports as PB-248610-SET.
HC \$59.00 CSCL 18E

The practical issues involved in analyzing whether or not the nuclear energy center concept should be implemented are explored. These include jurisdictional, institutional, and economic considerations; social, socioeconomic, and sociopolitical impacts; and accident risk, national disasters, national security, and nuclear materials safeguards implications. GRA

N76-24736# Nuclear Regulatory Commission, Washington, D.C. Office of Special Studies.

NUCLEAR ENERGY CENTER SITE SURVEY, 1975. EXECUTIVE SUMMARY

Jan. 1976 30 p

(PB-248611/6; NUREG-0001-ES) Avail: NTIS HC \$4.00 Also available in set of 7 reports as PB-248610-SET, HC \$59.00 CSCL 18E

N76-24740# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL STAND FOR INVESTIGATING MODELS OF ELECTROGASDYNAMIC ENERGY CONVERTERS

V. I. Orlando 9 Dec. 1975 13 p refs Transl. into ENGLISH from Kievsk. Inst. Grahdanskogoi Aviat., Sb. Nauchn. Tr. (USSR), no. 7, 1971 p 34-38
(AD-A019168; FTD-ID(RS)I-2426-75) Avail: NTIS CSCL 10/2

A general purpose experimental bench with an electrogasdynamic generator was designed and made. The bench can operate with various sources of charged particles. Preliminary experimental data obtained during tests are summarized. J.M.S.

N76-24744# Stanford Univ., Calif. Inst. for Energy Studies. **REPORT OF THE NSF-STANFORD WORKSHOP ON NET ENERGY ANALYSIS Final Report**

T. J. Connolly and J. R. Spraul Dec. 1975 219 p refs Workshop held at Stanford, Calif., 25-28 Aug. 1975 Prepared jointly with TRW Systems Group, Redondo Beach, Calif.
(Grant NSF GI-27976)
(PB-248603/3; TRW-27976-6001-RU-000) Avail: NTIS HC \$7.75 CSCL 10A

This workshop was convened to afford an opportunity for extended discussions on details of methodology and application of net energy analysis. The participants were divided into six small working groups. Their verbatim reports are included along with presentations made by recognized authorities on process, input-output and energetic methodology for net energy analysis. Initially the groups addressed methodological questions relating to net energy analysis such as appropriate measures of net energy, systems boundaries, intertemporal aspects, details of indirect energy calculations and preferred thermodynamic properties. Questions of a policy nature were then addressed. There was strong agreement that net energy analysis is best considered as a companion to economic, environmental and other analyses that might be appropriate to the question at hand. Other possible policy applications suggested for net energy analysis included evaluations of resource depletion, energy conservation options, energy content of foreign trade and energy impact of various laws and regulations. GRA

N76-24746# Combustion Engineering, Inc., Windsor, Conn. **ASSESSMENT OF THE CAPABILITY OF FIRING CLEAN LOW BTU GASES IN EXISTING COAL, OIL AND GAS-FIRED STEAM GENERATORS Final Report**

Dec. 1975 95 p refs Sponsored by Elec. Power Res. Inst. (PB-248328/7; EPRI-265-1) Avail: NTIS HC \$5.00 CSCL 10B

The objective of this study is to assess the capability of existing steam generating units in electric utility plants when firing low BTU gas (LBG). This includes: (1) determining the maximum generating capacity without making any modifications to existing pressure parts or auxiliary components; (2) establishing the minimum heating value of LBG that can be used to obtain original maximum continuous rating; (3) defining the alternations and estimating the order of magnitude costs which are required to achieve original maximum continuous rating; (4) providing performance data to make a comparative evaluation of LBG firing. This report includes an evaluation of five low BTU gases with higher heating values of 105 BTU/SCF, 128 BTU/SCF, 179 BTU/SCF, 292 BTU/SCF, and 396 BTU/SCF. Six typical modern type steam generating units were randomly selected for study. GRA

N76-25068# Denver Research Inst., Colo. Metallurgy and Materials Science Div.

SOLID-STATE HYDROGEN STORAGE MATERIALS OF

APPLICATION TO ENERGY NEEDS Semiannual Technical Report, 1 Jan. - 30 Jun. 1975

Charles E. Lundin and Frank E. Lynch Jul. 1975 31 p refs (Contract F44620-74-C-0020; ARPA Order 2552-1) (AD-A019528; AFOSR-75-1482TR; SATR-2) Avail: NTIS CSCL 07/4

During this period, four general areas of effort were pursued: (1) Design and construction were completed on a high pressure hydriding apparatus, which will reach about 2,000 bars in comparison with the 136 bars available in the present Sievert apparatus. Construction has had to include the pressure-measuring device for the upper two-thirds of the scale, not available commercially in non-hydrogen-embrittleable metal. (2) The major effort on rates of desorption of hydrogen from LaNi₅ was completed, after a number of reactor designs were employed in order to find the optimum conditions and purities. The first-cycle rate of desorption yields a second-order rate constant of 0.077 per second per unit ratio of H atoms to LaNi₅. Over the temperature range 15 to 25 C., the activation energy is 21.9 kcal/mole. (3) Poisoning of LaNi₅ by air, oxygen and water was studied up to 100 C with the conclusion that effects on hydriding are only temporary and limited to rate effects. (4) Preliminary hydrogen absorption-desorption measurements were made with 10 alloys and intermetallic compounds. These were selected compositions in the V-Cr and Nb-Mo systems, aluminum-saturated alpha-titanium, and the compounds CoTi, CeAl, CeAl₂, CeAl₄, and CeFe₅. A few of the results encourage further study. GRA

N76-25092# Stanford Research Inst., Menlo Park, Calif. DEPARTMENT OF DEFENSE MATERIALS CONSUMPTION AND THE IMPACT OF MATERIAL AND ENERGY RESOURCE SHORTAGES Final Report, Oct. 1974 - Nov. 1975

Mark D. Levine and Irving W. Yabroff Nov. 1975 160 p refs (Contract DAAH01-75-C-0173; ARPA Order 2865) (AD-A018613) Avail: NTIS CSCL 05/3

The purpose of this research was twofold: (1) to develop estimates of the amount of each of 17 critical materials consumed by U.S. industry to supply DOD final demand and to describe their direct and indirect flow through industry and (2) to analyze potential economic impacts of a shortage of one or more of these materials. Material consumption and flow analysis was performed for the following materials: aluminum, chromium, coal, cobalt, copper, lead, natural gas, nickel, petroleum, platinum, silver, tin, titanium metal, titanium pigment, tungsten, zinc castings, and zinc galvanizing. GRA

N76-25094# Committee on Interior and Insular Affairs (U. S. Senate).

ENERGY SUPPLY ACT OF 1974

Washington GPO 1974 159 p refs Rept. together with minority views to accompany S. 3221, 93d Congr., (S-Rept-93-1140) Avail: US Capitol, Senate Document Room 2d Sess., 9 Sep. 1974

A final report of the Senate Committee on Interior and Insular Affairs regarding proposed legislation regulating offshore energy exploration on the outer continental shelf is presented. The environmental effects on coastal regions from offshore drilling are discussed and the state of the art in offshore oil and gas extraction technology is analyzed. The economic and legal problems involved in government leasing of well sites are discussed. The full text of the proposed legislation is also presented. A.S.K.

N76-25439# RAND Corp., Santa Monica, Calif. POSSIBILITIES AND PROBABILITIES IN ASSESSMENT OF THE HAZARDS OF THE IMPORTATION OF LIQUIFIED NATURAL GAS

D. L. Jaquette Apr. 1975 22 p refs (AD-A019353; P-5411) Avail: NTIS CSCL 21/4

Release of Liquefied Natural Gas (LNG) from controlled containment, whether by accident, sabotage, or act of war,

presents a number of unique safety hazards. There are at least four main research areas that must be addressed in developing estimates of the risk to population and property of importation of large quantities of LNG. Here we examine the available research approaches directed toward one of these, the assessment of the possible release scenarios and in particular their associated probabilities. Criticism of certain of the assumptions and results made by some of the previous work in this area is discussed and because much of the work available to date is insufficient and incomplete in assessing the risks, the character and need for more research is discussed. Author (GRA)

N76-25490# Los Alamos Scientific Lab., N.Mex. USERDA DIVISION OF ELECTRIC ENERGY SYSTEMS, DC SUPERCONDUCTING POWER TRANSMISSION LINE PROJECT AT LASL Progress Report, 10 Apr. - 30 Jun. 1975

W. E. Keller, comp. and R. D. Taylor, comp. Dec. 1975 28 p refs (Contract W-7405-eng-36) (LA-6171-PR; PR-10) Avail: NTIS HC \$5.00

The tenth progress report of the Los Alamos Scientific Laboratory dc Superconducting Power Transmission Line (SPTL) Development Project covers the period April 1 to June 30, 1975. A number of line configurations, including a high voltage dc SPTL design, are examined from a cryoengineering point of view. New calculations on the cryostabilization of the superconductors are presented. Measurements of the critical current on several new superconductors and on a 20-m. well-stabilized Nb₃Sn tape are reported. Acoustical emission is being evaluated as a new technique to predetermine damage to Nb₃Sn conductors during cable fabrication. Author (ERA)

N76-25565# Committee on Commerce (U. S. Senate). AUTOMOBILE FUEL ECONOMY AND RESEARCH AND DEVELOPMENT ACT OF 1975

Washington GPO 1975 67 p refs Rept. together with additional views on S. 1883, 94th Congr., 1st Sess., 5 Jun 1975 (S-Rept-94-179; GPO-38-010) Avail: US Capitol, Senate Document Room

Details of proposed legislation to impose mandatory fuel economy standards for automobiles by 1980 are presented. The issues surrounding the need for fuel economy standards are analyzed and the feasibility of reaching the 1980 goal of 50 percent improvement in fuel economy is shown. The need for a greater federal role in automotive research and development is also demonstrated. A.S.K.

N76-25574# Webb Inst. of Naval Architecture, Glen Cove, N.Y.

EFFICIENT LOW-POWER OPERATION OF STEAM TURBINE MARINE POWER PLANTS Final Report

Jose Femenia Apr. 1975 25 p (PB-249011/8; NMRC-KP-140) Avail: NTIS HC \$3.50 CSCL 21G

As a result of recent large increases in the cost of fuel oil it has become necessary for ship operators to find ways of reducing fuel consumption. The results are described and summarized of a study to investigate possible fuel reduction measures. Five possible fuel saving techniques were investigated: propeller changes, turbine nozzle modifications, reduced pressure operation, use of cascading bleeds, and use of diesel-powered ship service generators. An evaluation of these techniques is given. GRA

N76-25575# California Univ., Berkeley. Dept. of Mechanical Engineering.

EMISSIONS AND FUEL ECONOMY OF A STRATIFIED CHARGE ENGINE OPERATING ON A GASOLINE METHANOL BLEND

K. Wolfe and M. C. Branch 1975 22 p refs Submitted for publication

(Grant NSF GI-44379)

(PB-249088/6; NSF/RA/N-75-214; WSS/C1Paper-75-9) Avail: NTIS HC \$3.50 CSCL 21B

Emissions and fuel economy of a large volume prechamber, fuel injected, stratified charge engine with gasoline and a gasoline/20% methanol blend were measured. The effect of both prechamber and main chamber mixture ratio on engine operation and emissions was investigated. Lowest overall emissions were achieved simultaneously with low fuel consumption at a prechamber equivalence ratio of 1.10. An improvement over the conventional engine in the area of NO emissions was found, but it is obtained with an increase in CO and HC emissions. The gasoline/methanol blend shows significant improvement over gasoline in NO emissions but also with higher exhaust CO. GRA

N76-25602# Office of Technology Assessment, Washington, D.C.

AN ANALYSIS OF THE FEASIBILITY OF SEPARATING EXPLORATION FROM PRODUCTION OF OIL AND GAS ON THE OUTER CONTINENTAL SHELF

May 1975 300 p refs

(PB-248381/6) Avail: NTIS CSCL 08I

A specific question arising out of both national and state concerns about Outer Continental Shelf (OCS) management is whether the national interest would be better served by separating OCS exploration from development and production, and, if so, by what means this would be best accomplished. The report contains the results of an analysis of the feasibility of separating exploration from production of oil and gas on the OCS and an analysis of the consequences likely to occur from such a separation. Author

N76-25603# Maritime Administration, Washington, D.C.

MARITIME ADMINISTRATION TITLE 11. VESSELS ENGAGED IN OFFSHORE OIL AND GAS DRILLING OPERATIONS Final Environmental Impact Statement

19 Jan. 1976 370 p refs

(PB-248857/5; MA-EIS-7302-76015F) Avail: NTIS HC \$10.50 CSCL 08I

Floating offshore oil and gas drilling units, and their support vessels are described. A general description is given of the marine environment, the possible impact on the environment that program vessels could have and the alternatives to Title 11 financing of such vessels. GRA

N76-25640# Oak Ridge National Lab., Tenn.

AGE OF SUBSTITUTABILITY: OR WHAT DO WE DO WHEN THE MERCURY RUNS OUT

H. E. Goeller and A. M. Weinberg 1975 50 p refs Presented at the 11th Ann. Found. Lecture on a Strategy for Resources, Eindhoven, Netherlands

(CONF-750973-1) Avail: NTIS HC \$5.50

The depletion of resources and substitution is discussed in three states. Stage I is a continuation of the present pattern of use of nonrenewable resources, persisting for perhaps another 30 to 50 years. In Stage II, lasting several hundred years, society will still depend on reduced C and H found in nature, i.e., coal; there will be little oil and gas, and people will begin to turn toward greater use of alloy steels (Al, Mg, and Ti). In Stage III, all fossil fuel will be gone; society will be based almost exclusively on materials that are virtually unlimited. It is believed that lifestyles in Stage III will not be drastically different from the present. The fission breeder, fusion (if feasible), or solar energy, in principle, could carry the energy budget in Stage III forever. It is concluded that for most of their uses, substitutes derived from infinite or near-infinite materials are available. Results are summarized for the case of mercury. ERA

N76-25646# Gulf Universities Research Consortium, Galveston, Tex.

A SURVEY OF FIELD TESTS OF ENHANCED RECOVERY

METHODS FOR CRUDE OIL Final Report

James M. Sharp 27 Dec. 1974 46 p Sponsored in part by FEA, Washington, D. C.

(Contract NSF C-942)

(PB-249050/6; GURC-140-S; NSF/OEP-76-0006) Avail: NTIS HC \$4.00 CSCL 08I

The purpose of this investigation was to determine whether or not industry is proceeding independently and at a rate sufficient to provide maximum and earliest domestic production to support the nation's crude oil requirements. GRA

N76-25648# National Oceanic and Atmospheric Administration, Rockville, Md. Office of Coastal Zone Management.

COASTAL MANAGEMENT ASPECTS OF OCS OIL AND GAS DEVELOPMENTS Technical Information Paper

Edward T. Laroe, Paul R. Stang, Katharine H. Conroy, David W. Laist, and Trevor Q. Neill Jan. 1975 90 p refs

(PB-249751/9; NOAA-76011504) Avail: NTIS HC \$5.00 CSCL 08I

This report provides a brief overview of Outer Continental Shelf (OCS) petroleum activities and a description of: Federal OCS responsibilities and roles, offshore and onshore activities associated with OCS operations, socioeconomic and environmental impacts deriving from those activities and suggestions for planning and management for OCS developments. The annotated bibliography describes the OCS-related portions of the literature cited. A directory of agencies and organizations involved with OCS oil and gas related activities is included. GRA

N76-25649# Bureau of Mines, Denver, Colo. Intermountain Field Operation Center.

THE RESERVE BASE OF US COALS BY SULFUR CONTENT PART 2: THE WESTERN STATES

Patrick A. Hamilton, D. H. White, Jr., and Thomas K. Matson Nov. 1975 329 p refs

(PB-249702/2; BM-IC-8693-Pt-2) Avail: NTIS CSCL 08I

The coal reserve base of anthracite, bituminous, and subbituminous coals, and lignite is delineated by mining method and sulfur content, for coal-bearing states west of the Mississippi River. The reserve base of low-sulfur coal, = or < 1.0 percent sulfur is 167,324.5 million tons; medium-sulfur coal, 1.1 to 3.0 percent sulfur, is 37,529.2 million tons, and high-sulfur, > 3.0 percent sulfur, is 11,244.1 million tons. The reserve base of coal with an unknown sulfur content is 18,323.0 million tons. Resource and reserve definitions used were jointly defined by the U.S. Bureau of Mines and the U.S. Geological Survey. GRA

N76-25650*# Scientific Translation Service, Santa Barbara, Calif. **ANALYSIS OF TECHNOLOGICAL DEVELOPMENT PROBLEMS POSED BY THE USE OF ORBITAL SYSTEMS FOR ENERGY CONVERSION AND TRANSFER IN AND FROM SPACE Final Report**

D. Koehn, K. Jesche, J. Rath, D. Teichmann, G. Wirths et al Washington: NASA Jun. 1976 500 p refs Transl. into ENGLISH of AEG Telefunken (Backnang), May 1975 502 p (Contract NASw-2791)

(NASA-TT-F-16923) Avail: NTIS HC \$12.50 CSCL 10A

Current American and European concepts of a solar satellite power station with associated technological problem areas are studied. Solar arrays, liquid gallium as a collecting contact, amplifiers and phased array earth antennas for microwave transmission and reception, respectively, and associated technological and theoretical implications, as well as typical spacecraft optimization problems are considered in detail. Author

N76-25651# Committee on Labor and Public Welfare (U. S. Senate).

UNEMPLOYMENT AND THE ENERGY CRISIS, 1974

Washington GPO 1974 226 p refs Joint hearings before Subcomm. on Employment, Poverty, and Migratory Labor and the Special Subcomm. on Human Resources of Comm. on Labor and Public Welfare, 93d Congr., 2d Sess., 14 Feb. 1974 (GPO-40-499) Avail: Subcomm. on Employment, Poverty, and Migratory Labor

The problem of unemployment and its aggravation by the Arab oil embargo and increasing oil prices was discussed. Possible remedies to these problems were considered. D.M.L.

N76-25652# Committee on Interior and Insular Affairs (U. S. Senate).

EXECUTIVE ENERGY MESSAGES

Washington GPO 1975 332 p refs Publication pursuant to S. Res. 45, 94th Congr., 1st Sess., 1975

(GPO-57-219) Avail: Comm. on Interior and Insular Affairs

A collection of major Presidential energy statements, dating from June 4, 1971 to July 21, 1975, is presented. Topics include crude oil supplies and prices, the utilization of nuclear energy, coal, and various other energy sources, fuel conservation, environment protection, and governmental actions in these areas. D.M.L.

N76-25653# Committee of Conference (U. S. Congress).

ENERGY POLICY AND CONSERVATION ACT From Committee of Conference

Washington GPO 1975 99 p S. 622 enacted into law by the 94th Congr., 22 Dec. 1975

(Pub-Law-94-163; GPO-57-081) Avail: US Capitol. Senate Document Room

The Act to increase domestic energy supplies; to restrain energy demands; and to prepare for energy emergencies is reported. Topics discussed include: domestic supply availability, standby energy authorities, improving energy efficiency, and petroleum pricing policy. F.O.S.

N76-25654# Committee on Commerce (U. S. Senate).

ADEQUATE SUPPLIES OF ENERGY TO THE TOURISM INDUSTRY

Washington GPO 1974 391 p refs Hearings on S. Res. 281 before Subcomm. on Foreign Commerce and Tourism of Comm. on Commerce, 93d Congr., 2d Sess., 29 Mar. - 1 Apr. 1974

(GPO-32-093) Avail: Subcomm. on Foreign Commerce and Tourism

Statistics on the United States share of the International Travel Market are examined. Domestic fuel consumption resulting from tourist travel is analyzed. The economic importance of tourism to the United States is reviewed. J.R.T.

N76-25657# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.

ANALYZING SYNCRUDE FROM WESTERN KENTUCKY COAL

G. P. Sturm, Jr., P. W. Woodward, J. W. Vogh, S. A. Holmes, and J. E. Dooley Nov. 1975 31 p refs

(BERC/R1-75/12) Avail: NTIS HC \$4.00

A synthetic crude oil derived from western Kentucky coal by the charoil-energy development process was separated into two distillates and a residuum fraction. The lower boiling distillate was further separated by chemical extractions and chromatography and was characterized by gas chromatography and spectral techniques. The higher boiling distillate and the residuum were further separated and characterized largely by methods developed by the ERDA Energy Research Centers for characterization of heavy ends of petroleum. The results obtained were similar to those for the Utah syncrude that was characterized by ERDA and showed the syncrudes contained hydrocarbon types similar to those found in petroleum crudes. However, the syncrudes were more aromatic in character with substitution of shorter alkyl groups on the aromatic rings. They also contained appreciable amounts of oxygenates and had a fairly uniform distribution of nitrogen compounds across the boiling range. Author (ERA)

N76-25658# California Univ., Livermore. Lawrence Livermore Lab.

HIGH EXPLOSIVE FRACTURING STUDIES IN COAL

J. R. Hearst and D. B. Larson 19 Sep. 1975 16 p refs

(Contract W-7405-eng-48)

(UCRL-51909) Avail: NTIS HC \$4.00

In situ coal gasification using chemical high explosives to

fracture coal at depth is described. The one-dimensional Lagrangian elastic-plastic brittle-failure computer program SOC was used to compute epsilon, sub f the total failure-induced shear strain, for coal, epsilon sub f was then associated with shot-induced fracture in coal and the corresponding permeability change. In laboratory experiments permeability was measured as a function of radius from the shot, postshot. Epoxy was injected into the shot hole, the coal sectioned, and the observed cracks compared with calculations. The primary measurements in the field experiment were preshot and postshot permeability, preshot and postshot fracture frequency in cores, acoustic velocity as a function of depth, penetration of dye from the shot hole, ease of drilling post-shot holes, attenuation of acoustic waves passing through the shot region, and electrical resistivity and attenuation of electrical signals passing through the shot region. Author (ERA)

N76-25659# California Univ., Livermore. Lawrence Livermore Lab.

METHANOL FROM IN SITU COAL GASIFICATION

R. B. Carr, ed., J. M. Barnett, ed., R. C. Berlo, ed., C. S. McCaleb, ed., and J. K. Prono, ed. Sep. 1975 30 p refs Sponsored by ERDA

(UCRL-52000-75-9) Avail: NTIS HC \$4.00

Methanol (methyl alcohol) is a convenient way to use coal as a fuel in internal combustion engines and thus move toward self-sufficiency in the transportation sector. The production route is conversion of coal to synthesis gas (carbon monoxide and hydrogen), which is converted catalytically under high pressure to methanol. The enabling technology may be in situ coal gasification: cheaper than conventional mining and surface gasification, with less environmental impact and the capability for exploiting deep coal seams that cannot be mined economically. For in situ gasification, the capital requirements are estimated to \$354 million (1974 dollars) for a 13,600-tonne-per-day methanol plant. In terms of energy output, this corresponds to 85,500 TJ (81 trillion Btu) annually. Projected plant or refinery costs are \$0.99 per GJ (1.04 per million Btu); 5.9 cents per gallon or 1.6 cents per litre. Adding distribution costs and taxes, we calculate a delivered pump price that is economically competitive with gasoline. Author (ERA)

N76-25660# Oak Ridge National Lab., Tenn.

COAL TECHNOLOGY PROGRAM Progress Report, Aug. 1975

Oct. 1975 41 p refs

(Contract W-7405-eng-26)

(ORNL-TM-5092) Avail: NTIS HC \$4.00

This report, the thirteenth of a series, is a compendium of monthly progress reports for the ORNL research and development projects that are in support of the increased utilization of coal as a source of clean energy. The projects reported this month include those for hydrocarbonization, solid-liquid separations, chemical research and development, analytical chemistry, engineering evaluations of nuclear process heat for coal conversion, coal-fueled MIUS, engineering evaluations of the Hydrocarbonization and Synthoil processes, and biomedical and environmental research. Author (ERA)

N76-25661# Oak Ridge National Lab., Tenn.

COAL TECHNOLOGY PROGRAM Progress Report, Sept. 1975

Oct. 1975 25 p refs

(Contract W-7405-eng-26)

(ORNL-TM-5124) Avail: NTIS HC \$4.00

This report, the fourteenth of a series, is a compendium of monthly progress reports for the ORNL research and development projects that are in support of the increased utilization of coal as a source of clean energy. The projects reported this month include those for hydrocarbonization, solid-liquid separations, chemical research and development, analytical chemistry, engineering evaluations of nuclear process heat for coal conversion, coal-fueled MIUS, and engineering evaluations of the Hydrocarbonization and Synthoil processes. Author (ERA)

N76-25662# Oak Ridge National Lab., Tenn.
EVALUATION OF CURRENT PROCESS TECHNOLOGY IN COAL CARBONIZATION AND HYDROCARBONIZATION
 J. M. Holmes, H. D. Cochran, Jr., M. S. Edwards, D. S. Joy, and P. M. Lantz 1975 30 p refs Presented at the 68 Ann. Meeting of Am. Inst. of Chem. Eng., Los Angeles (CONF-751107-1) Avail: NTIS HC \$4.50

It is shown that a number of processes for carbonization and hydrocarbonization of bituminous coals are available but only one, the Lurgi-Ruhr gas process, is developed to a commercial stage. A wide range of yields can be obtained by these processes which are primarily dependent upon coal rank and process operating conditions. Agglomeration of the coal during carbonization can be prevented by a variety of methods; the most attractive one appears to be the bed recirculation method. Finally, desulfurization of the liquid and char products is achieved by additional treatment with hydrogen but in the case of the char, beneficiation of the feed coal is necessary. Author (ERA)

N76-25663# Bechtel Corp., San Francisco, Calif.
PRELIMINARY ANALYSIS OF DIRECT RESOURCE REQUIREMENTS FOR THREE SYNTHETIC FUEL SCENARIOS
 M. Carasso, J. M. Gallagher, and K. J. Sharma Jul. 1975 91 p Sponsored by ERDA (FE-1808-1) Avail: NTIS HC \$7.75

A brief analysis is presented of the capital, manpower, and material resources requirements needed to implement the President's Energy Program of January 1975, the highlights of which were presented in the 1975 State of the Union message. Three separate scenarios for the development of a synthetic fuels industry to a level of 1 million bbl/day by 1985 are emphasized primarily. Because the work was carried out prior to the availability of a complete specification of the President's Energy Program, the analysis is based on a preliminary interpretation of the program. A model is presented for developing annual schedules for addition of energy facilities required to meet contemplated energy needs until 1995; specifically, the model is applied to two fuel mixes which represent perturbations of the synthetic fuel scenario. ERA

N76-25664# Energy Research and Development Administration, Washington, D.C.
FOSSIL ENERGY RESEARCH PROGRAM Summary Status Report, Fourth Quarter FY75
 15 Aug. 1975 102 p refs (ERDA-45-75/4) Avail: NTIS HC \$8.25

Summary charts depicting the Fiscal Year 1975 fourth quarter status of ERDA Fossil Energy Research Programs are presented. These status charts are based both on planning material and on inputs received from organizations performing the planned research. These are the standard products of the Energy Research Program Information System (ERPIS), developed for management needs for the ERDA Fossil Energy Program. Sufficient summary materials is presented to provide a general understanding of the current status of the Fossil Energy Research Program.

Author (ERA)

N76-25665# Brookhaven National Lab., Upton, N.Y.
TARGET CAPITAL COSTS FOR THE IMPLEMENTATION OF FUEL CELLS AND ELECTRIC STORAGE DEVICES WITHIN THE NATIONAL ENERGY SYSTEM
 C. Braun, E. A. Cherniavsky, and F. J. Salzano 1975 34 p refs Presented at the Fall Meeting of the Electrochemical Soc., Dallas (BNL-20523; Conf-751032-1) Avail: NTIS HC \$5.00

The allowed capital cost for the introduction of fuel cells and electric storage devices into the year 1985 national energy system are examined, utilizing the Brookhaven Energy System Optimization Model (BESOM). The storage devices are characterized by their overall electric-to-electric conversion efficiencies and by their expected lifetimes which are varied parametrically, over the entire range of feasible efficiencies and lifetimes. The possible introduction of electric storage plants to intermediate load service at a load factor of 0.50 and to both intermediate and peaking load generation when operating on a weekly instead of a daily cycle, is considered. The capital costs at which these

devices become economically attractive are calculated using the marginal values obtained from the linear programming problem solution. Author (ERA)

N76-25666# Brookhaven National Lab., Upton, N.Y.
ROLE AND ALLOWED COSTS OF FUEL CELLS AS ELECTRIC GENERATING DEVICES
 C. Braun, E. A. Cherniavsky, and F. J. Salzano Sep. 1975 40 p refs Sponsored by ERDA (BNL-20504) Avail: NTIS HC \$3.75

The break even capital costs for introducing fuel cells burning different fuels into the year 1985 national energy system are considered. Four types of electric generating systems are discussed: distillate oil and natural gas fuel cells, hydrogen electric storage system based on hydrogen produced from off-peak power, and fuel cell generators based on hydrogen produced from coal gasification. Each generating device is characterized by its fuel to electric conversion efficiency, by the utilization factor, and the useful lifetime. The expected lifetime is reflected in the value of the capital recovery factor utilized in the cost computations. The current series of computations assume a 0.15 capital recovery factor, which is based on an assumed lifetime of 30 years and 14.76 percent amortization rate. ERA

N76-25668# Institutul de Fizica Atomica, Bucharest (Romania).
USE OF A CONVERTED MAGNETRON FOR MAKING ELECTRIC GENERATOR WITH RADIOISOTOPES OR A CONVERTING CELL OF THE FISSION NUCLEAR ENERGY
 G. Cristea and G. Fratiloiu Jun. 1975 15 p refs (IFA-FR-138-1975) Avail: ERDA Depository Libraries HC \$3.50

The principle of the electric generator with radioisotopes as well as of the converting cell of the fission nuclear energy using a modified magnetron is explained. Both the electric generator with radioisotopes and the converting cell of the fission nuclear energy represent energy sources supplied in the form of microwaves, the main power source, and of direct current, the secondary reduced power source. Author (NSA)

N76-25669# Delaware Univ., Newark. Inst. of Energy Conversion.
RESEARCH DIRECTED TO STABLE HIGH EFFICIENCY CDS SOLAR CELLS Quarterly Progress Report, 1 Jul. - 30 Sep. 1975

J. D. Meakin Nov. 1975 85 p refs (Grant NSF AER-72-A04) (PB-248859/1; NSF/RA/N-75-207) Avail: NTIS HC \$5.00 CSCL 10B

Various techniques are being used to produce mixed (ZnCd)S films. The influence of deposition parameters on spectral response, electrical characteristics, structure and junction capacitance are reported. The spatial distribution of Cu₂S in the cells has been explored. Further heat treatment effects related to the presence of oxygen are described. Theoretical studies include the analysis of published data on the relation between capacitance and the interface collection factor, and the influence of Cu₂S stoichiometry and distribution on cell performance. GRA

N76-25671# City Coll. of the City Univ. of New York. Dept. of Chemical Engineering.
CITY COLLEGE STUDIES OF THE COALPLEX
 1975 18 p (Contract NSF GI-34286) (PB-249121/5; NSF/RA/N-75-218) Avail: NTIS HC \$3.50 CSCL 07A

Improved techniques for gasifying coal are considered. The primary objective is to study chemistries and unit operations that will be useful in a coalplex yielding substitute natural gas, high octane gasoline, and clean electricity. Flowsheet studies to identify commercial opportunities and to guide experimental work are also being carried out. Chapter headings are as follows: (1) Reaction of coal and hydrogen; (2) kinetics of carbon gasification; (3) the fast fluidized bed; (4) agglomerating fluidized beds; (5) sulfur absorption kinetics; (6) the panel bed filter; and (7) flowsheet and system studies. GRA

N76-25672# New York State Senate, Albany.

THE NORTHEASTERN STATES CONFRONT THE ENERGY CRISIS: PAPERS OF THE REGIONAL RESPONSE TO THE ENERGY CRISIS: A CONFERENCE OF STATE LEGISLATIVE LEADERS FROM THE NORTHEASTERN STATES

Jay P. Rolison, Jr. Nov. 1975 316 p. refs Conf. held at New York, Dec. 1974

(Grant NSF GT-43894)

(PB-248997/9; NSF/RA/G-75-050) Avail: NTIS HC \$9.75 CSCL 10A

A partial listing of topics includes: The regional economic and environmental impact of energy; nuclear energy, the intermediate solution; coal energy of the past or future; alternate sources of energy - their potential and feasibility; the potential of regional energy modeling; effects of energy shortages on the way we live; an evaluation of mechanisms by which state legislators can obtain improved access to information on energy issues; energy regulation; a summary view of federal limitations on state and local governments; on taxes and subsidies to affect energy consumption; and efficiency and equity considerations.

GRA

N76-25675# Institute of Gas Technology, Chicago, Ill.

ASSESSMENT OF PRIVATE SECTOR FUNDING OF ENERGY R AND D Final Report

Nicholas Biederman, Peter Ketels, Kenneth Burnham, William Conaghan, and Daniel Barszcz 15 Mar. 1975 58 p. refs (Contract NSF C-924)

(PB-249136/3) Avail: NTIS HC \$4.50 CSCL 10A

Information on energy R&D in the private sector (manufacturers and utilities) is provided to serve as an input for planning government programs. Information provided consists of reported funding levels in 1973 and 1974 for a sample of 130 manufacturers and in 1973 for interstate natural gas pipeline companies and electric utilities as reported to the Federal Power Commission. An estimate of total energy R and D funding in 1973 by the private sector based on this sample is also provided. Manpower expenditure is discussed.

GRA

N76-25676# Federal Energy Administration, Washington, D.C.
REPORT TO CONGRESS ON THE ECONOMIC IMPACT OF ENERGY ACTIONS AS REQUIRED BY PUBLIC LAW 93-275, SECTION 18(D)

Jul. 1975 124 p. refs

(PB-249330/2; FEA/B-75/376) Avail: NTIS HC \$5.50 CSCL 10A

An assessment of the economic impact of the energy situation is provided for the 6 month period starting with the fourth quarter of 1974 and ending with the first quarter of 1975. Significant findings include the following: U.S. consumption of energy declined for the first time in 20 years; employment in energy producing sectors increased; the severe impact of energy prices on the rate of inflation abated toward the end of 1974 and in early 1975; and natural gas curtailment resulted in lost production and increased cost in some industries. After a deficit of more than \$5 billion in 1974, the U.S. merchandise trade balance showed as surplus of \$1.8 billion in the first quarter of 1975.

GRA

N76-25677# Enviro-Management and Research, Inc., Washington, D.C.

EVALUATION OF BUILDING CHARACTERISTICS RELATIVE TO ENERGY CONSUMPTION IN OFFICE BUILDINGS Final Report

22 Sep. 1975 69 p

(Contract FEA-C-04-50222-00)

(PB-248774/2; FEA/D-76/006) Avail: NTIS HC \$4.50 CSCL 13A

Data on a limited sample of office buildings are surveyed in order to identify those factors which have an impact on energy consumption. Such data can be used for the development of coefficients for monitoring energy consumption, or as the basis of future research.

GRA

N76-25679# Electric Power Research Inst., Palo Alto, Calif.
USE OF NUCLEAR PLANT OPERATING EXPERIENCE TO GUIDE PRODUCTIVITY IMPROVEMENT PROGRAMS

Melvin E. Lapidès and Edwin Zebroski Nov. 1975 120 p. refs (PB-249018/3; EPRI-SR-26-R) Avail: NTIS HC \$5.50 CSCL 18E

The results of an extended evaluation of the operational performance of domestic, light water reactor nuclear electric generating units are given. Relevant operating and outage data have been compiled and analyzed to help quantify priorities for productivity improvement programs. Two main topics are covered: (a) the compilation, analysis and convenient display of sources of outage of system and component, and (b) a quantitative method for selecting R and D efforts on the basis of projected gain in plant productivity.

GRA

N76-25681# Ultrasystems, Inc., Phoenix, Ariz. Dynamic Science Div.

FEA/C AND E RD AND D FIVE YEAR MASTER PROGRAM PLAN

Washington FEA Oct. 1974 152 p. Sponsored by FEA

(Contract DI-14-01-0001-1800)

(PB-249453/2; Rept-9999-75-3; FEA/D-76/015) Avail: NTIS HC \$6.75 CSCL 10A

This Five Year Master Program Plan (MPP) was prepared to meet the overall conservation goals of project Independence. It constitutes a program for the creation, management, and execution of a systematic RD and D operations plan which will provide for continuous evaluation and development of optimum project achievement strategies. It strives after maximum, effective application of all resources bearing on energy conservation.

GRA

N76-25682# Eidgenossiches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland).

HYDROGEN STORAGE AND TRANSMISSION METHODS

W. Seifritz Aug. 1975 35 p. refs

(EIR-288) Avail: NTIS

Hydrogen can be stored in four forms: as a gas under pressure, cryogenic storage as liquid, in the form of metallic hydrides, and storage in various chemical forms. These different forms are discussed in more detail. Furthermore, the transmission of hydrogen in cross-country pipelines, together with an economic analysis and a comparison with natural gas transmission is presented.

Author (ERA)

N76-25689# California Univ., Livermore. Lawrence Livermore Lab.

COMPREHENSIVE APPROACH FOR EVALUATING THE ENVIRONMENTAL AND HUMAN HEALTH EFFECTS OF COAL-FIRED ELECTRICITY PRODUCTION IN THE SOUTHWEST

D. L. Ermak, J. R. Kercher, and R. L. Ritschard 2 Oct. 1975 37 p. refs Presented at Proc. of Disturbed Lands Reclamation and Use in the Southwest, Tucson, Ariz., Nov. 1975

(Contract W-7405-eng-48)

(UCRL-77303; Conf-751118-1) Avail: NTIS HC \$5.00

The approach developed by the Regional Studies Group at LLL for evaluating the environmental impacts of coal-fired electricity production in the southwestern United States is presented. The electric power generation process is divided into four components: coal mining; coal transportation; electric power generation; and electric power transmission and each is considered for possible sources of environmental degradation. In the case of pollutants, the possible transport pathways through the environment are identified. Environmental effects are discussed under the headings of atmospheric; land and soil; hydrospheric; biotic; and human health. For each effect the method and data required for evaluating the magnitude of the effect are stated. The effects that are expected to be most significant are identified.

Author (ERA)

N76-25692# United Technologies Research Center, East Hartford, Conn.

**FUEL GAS ENVIRONMENTAL IMPACT: PHASE REPORT
Report for period ending 1 Jul. 1973 - 1 Nov. 1974**

Fred L. Robson, Albert J. Giramonti, William A. Blecher, and Gerald Mazzella (Foster Wheeler Corp., Livingston, N. J.) Nov. 1975 314 p refs

(Contract EPA-68-02-1099)

(PB-249454/O: EPA-600/2-75-078) Avail: NTIS HC \$9.75
CSCL 07A

The technical and economic feasibility is considered of: (1) Lurgi-type fixed bed gasifiers and BCR-type entrained flow gasifiers in combination with low- and high-temperature fuel gas cleanup systems; (2) advanced technology combined-cycle power systems; and (3) integrated gasification systems, cleanup processes, and power systems. Processes and systems considered were those using technology both currently available for power station configurations which the contractor judged could appear in commercial applications in the 1975 to 1978 time frame and potentially applicable in the 1980 decade time period. GRA

N76-25744# Committee on Science and Technology (U. S. House).

**LEGISLATION FOR OUTER CONTINENTAL SHELF R
AND D. VOLUME 1: WITNESSES**

Washington GPO 1975 840 p refs Hearings before Subcomm. on Energy Res., Development and Demonstration (Fossil Fuels) of Comm. on Sci. and Technol., 94th Congr., 1st Sess., No. 22, 8-11 Jul. 1975

(GPO-58-926) Avail: Subcomm. on Energy Res., Development and Demonstration (Fossil Fuels)

Legislation pertaining to the development of coal, oil, and natural gas resources in the United States is presented. Geological surveys of on-shore and off-shore (Continental Shelf) sites are examined. Projections and statistics on the amount of coal, oil, and gas that are expected, based on geological surveys, are given. Maps of submarine topography along U.S. coastlines are shown. The role of government and industry in the development of these fossil fuel resources is examined. Also examined are ecological effects of offshore oil exploration of the Continental Shelf. J.R.T.

N76-25877# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.

**MATHEMATICS IN SCIENCE, ENGINEERING, AND ENERGY
PROCESSES Progress Report, 1 Jun. 1974 - 31 May 1975**

Richard Bellman 1975 26 p refs

(Contract AT(04-3)-113; Grant NSF MPS-74-15650)

(USC-133P19-92) Avail: NTIS HC \$5.00

The activities of the members of the Electronic Sciences Laboratory at the University of Southern California in the area of mathematics as applied to science engineering, and energy processes are briefly reviewed. ERA

N76-26036# Oak Ridge National Lab., Tenn. Information Div.

**INFORMATION SUPPORT OF ENERGY RESEARCH AND
DEVELOPMENT ADMINISTRATION'S ENVIRONMENTAL
PROGRAM AT OAK RIDGE NATIONAL LABORATORY**

G. U. Ulrikson 1975 48 p refs Presented at 3rd ERDA Environ. Protect. Conf., Chicago, 23 Sep. 1975

(Contract W-7405-eng-26)

(CONF-750967-10) Avail: NTIS HC \$5.50

The primary function of the Information Center Complex (ICC) at Oak Ridge National Laboratory, Oak Ridge, Tennessee, is to develop and correlate the information activities of the energy and related environmental research projects at ORNL and to systematize operations to achieve maximum response to the information needs of funding agencies and user community. The development of new data bases and information services as need arises is a major responsibility of ICC. Interactions among segments of ICC provide for a wide range of analysis and synthesis of knowledge, resulting in a synergistic effect. Present methods used to retrieve environmental information from the scientific literature are reviewed with respect to specific procedures

employed by ICC, and the use of highly specialized data bases in relation to manual and computerized sources is discussed. Procedures employed for different types of queries and the search strategy utilized are summarized indicating the extent of coverage from the various data bases. Author (ERA)

N76-26039# Committee on Interior and Insular Affairs (U. S. Senate).

OIL PRICE DECONTROL

Washington GPO 1975 402 p refs Hearings pursuant to S. Res. 45 before Comm. on Interior and Insular Affairs, 94th Congr., 1st Sess., 4-5 Sep. 1975

(GPO-59-965) Avail: Comm. on Interior and Insular Affairs

The impact of permitting the decontrol of petroleum prices and the termination of allocation authority are examined. Factors considered include: the effect on the cost of living, the effect to competition, and the effect on the economy. J.M.S.

N76-26042# Committee on Commerce (U. S. Senate).

NATURAL GAS EMERGENCY ACT OF 1975

Washington GPO 1975 103 p refs Hearing on S. 2244, S. 2310, and S. 2330 before Comm. on Commerce, 94th Congr., 1st Sess., 15 Sep. 1975

(GPO-59-019) Avail: Comm. on Commerce

Emergency measures to assure the availability of adequate supplies of natural gas are considered. Priorities for interstate purchasers and suppliers are established. Possible conversions of electric power plants to coal and oil are projected in order to make additional supplies of natural gas available. Also contemplated is a maximum efficient rate of production for designated natural gas fields. G.G.

N76-26043# Committee on Appropriations (U. S. Senate).

**PUBLIC WORKS FOR WATER AND POWER DEVELOPMENT
AND ENERGY RESEARCH APPROPRIATIONS. PART 5:
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRA-
TION**

Washington GPO 1975 1232 p refs Hearings on H.R. 8122 before a subcomm. of the Comm. on Appropriations, 94th Congr., 1st Sess., 16 Apr. 1975

(GPO-52-465) Avail: Comm. on Appropriations

Hearings on the FY 1976 budget request and following transition quarter appropriations for the public works appropriation bill are presented. The proposed budget for the Energy Research and Development Administration is discussed. Programs considered include: fossile energy development; nuclear energy development; fusion power research and development program; solar, geothermal, and advanced energy systems development; energy conservation, environmental and safety research; weapons program; and laser fusion program. J.M.S.

N76-26044# Committee on Public Works (U. S. Senate).

**TRANSPORTATION PLANNING AND PRIORITIES FOR THE
SEVENTIES, ATLANTA, GEORGIA, PART 5**

Washington GPO 1974 144 p refs Hearings before Subcomm. on Transportation of Comm. on Public Works, 93d Congr., 2d Sess., 10 May 1974

(GPO-37-075) Avail: Subcomm. on Transportation

Urban transportation is discussed in terms of future financing of highways and mass transit, energy conservation, and long-term planning. The coordination and financing of state and Federal programs is emphasized. J.M.S.

N76-26045# Committee on Public Works (U. S. Senate).

**TRANSPORTATION PLANNING AND PRIORITIES FOR THE
SEVENTIES, SAN FRANCISCO AND LOS ANGELES,
CALIFORNIA, PART 6**

Washington GPO 1974 634 p refs Hearings before Subcomm. on Transportation of Comm. on Public Works, 93d Congr., 2d Sess., 24-25 May 1974

(GPO-37-741) Avail: Subcomm. on Transportation

N76-26299# European Space Agency, Paris (France).

HYDROGEN PRODUCTION BY WATER ELECTROLYSIS

Andreas Gann Feb. 1976 58 p refs Transl. into ENGLISH of 'Ueber die Herstellung von Wasserstoff durch Wasserelektrolyse'. DFVLR, Stuttgart Report DLR-Mitt-74-39, 30 Oct. 1974 Original German report available from DFVLR, Porz, West Ger. DM 24.60

(ESA-TT-250; DLR-Mitt-74-39) Avail: NTIS HC \$4.50

A survey is presented of the operation, design and economic viability of large-scale plants for the production of hydrogen by electrolysis. The present state of the development of modified processes is examined. Author (ESA)

N76-26626*# Earth Satellite Corp., Washington, D.C.

APPLICATION OF LANDSAT-2 DATA TO THE IMPLEMENTATION AND ENFORCEMENT OF THE PENNSYLVANIA SURFACE MINING CONSERVATION AND RECLAMATION ACT Progress Report, 19 Mar. - 19 Jun. 1976

Orville R. Russell, Principal Investigator 19 Jun. 1976 5 p ERTS

(Contract NAS5-21998)

(E76-10398; NASA-CR-148185; C-1037-2-5;

Rept-21570-2-5) Avail: NTIS HC \$3.50 CSCL 08I

N76-26635* Geological Survey, Washington, D.C.

DEPARTMENT OF THE INTERIOR PROGRAM

James R. Balsley *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 2-A Jun. 1975 p 33-36

CSCL 05A

The remote sensing activities of the Department of Interior are summarized. The use of satellite imagery in land and water management is described. Specific topics discussed include: land use mapping, exploration and discovery of metal, oil, and gas deposits, location of geological faults, and repetitive monitoring of dynamic environmental phenomena related to water resources. J.M.S.

N76-26642* Chevron Oil Field Research Co., La Habra, Calif.

GEOLOGY, SUMMARY

Floyd F. Sabins, Jr. *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 2-A Jun. 1975 p 99-121 refs

CSCL 08G

Trends in geologic application of remote sensing are identified. These trends are as follows: (1) increased applications of orbital imagery in fields such as engineering and environmental geology - some specific applications include recognition of active earthquake faults, site location for nuclear powerplants, and recognition of landslide hazards; (2) utilization of remote sensing by industry, especially oil and gas companies, and (3) application of digital image processing to mineral exploration. Author

N76-26661* Joint Federal-State Land Use Planning Commission for Alaska, Juneau.

ALASKA'S NEEDS IN REMOTE SENSING

John L. Hall *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 2-B Jun. 1975 p 315-318

CSCL 05B

Joint Federal/State remote data sensing centers are advocated to help survey Alaska for land use planning by aerial photography and LANDSAT imagery. The centers are to provide satellite derived information in land use planning and offshore oil developments. G.G.

N76-26672# Florida State Univ., Tallahassee. Dept. of Urban and Regional Planning.

FLORIDA COASTAL POLICY STUDY: THE IMPACT OF OFFSHORE OIL DEVELOPMENT Final Report

Allen L. Pearman and John W. Stafford (Univ. of South Fla.)

Jun. 1976 284 p refs

Avail: NTIS HC \$9.25

The impacts of possible offshore oil and gas discoveries upon the coastal areas of Florida are examined. Offshore oil and gas developments are studied from a number of perspectives: economic, environmental, legal, and social. A set of policy alternatives are identified which can be implemented to guide and regulate onshore developments so as to minimize the adverse impacts upon the areas most directly affected. The analysis of onshore impacts is based, in part, upon a review of similar developments in other coastal areas. The development of an information base which can be applied to potential developments in Florida is viewed as an essential element of this study.

Author

N76-26678 Clemson Univ., S.C.

A TOTAL SYSTEMS PLAN FOR A MOBILE SOLAR LABORATORY Ph.D. Thesis

Ibrahim Khaled Kellizy 1975 316 p

Avail: Univ. Microfilms Order No. 76-12960

The performance of a hypothetical solar house in Clemson, South Carolina, is simulated using insolation and weather data in addition to conservative heat loss estimates. Based on the simulation, parametric system design and optimization are undertaken. The potential and impact of solar energy utilization is considered in the sphere of a national energy policy. A public education program is developed for a mobile solar laboratory to tour Southeastern States. Statistical analysis of solar radiation and weather parameters at various locations in the Southeast is undertaken. The selection of cities to be visited by the solar laboratory is based on the dual objective of (1) demonstrating solar systems to the public and (2) collecting weather and performance data at different climatological areas. Industry demand schedules and elasticities of demand are developed, and the feasibility of solar energy utilization is analyzed.

Dissert. Abstr.

N76-26679 Wisconsin Univ., Madison.

ECONOMICS OF SUPERCONDUCTIVE ENERGY STORAGE INDUCTOR-CONVERTER UNITS IN POWER SYSTEMS Ph.D. Thesis

Sambasiva Rao Yadavalli 1975 182 p

Avail: Univ. Microfilms Order No. 76-6114

The economic aspects of using superconductive energy storage inductor converter units (IC units) in large power systems for peak shaving and load leveling were studied. The daily load characteristics of power systems, electrical external circuit losses in the IC units and the advantages and disadvantages of IC units were considered. The peak power problem in power systems and the status of various peaking alternatives were investigated, and daily load model was developed. The competitiveness of IC units with other peaking units was then investigated; advantages and disadvantages were translated into credits and debits. Large IC units were found to be economically competitive with other peaking alternatives. External electrical circuit losses were determined to have negligible effect on their storage and power capacities. Credits which could be of significant economic value to IC units are a transmission credit (typically about \$35/kW), a pollution credit (typically about \$80/kW), and a spinning reserve credit (typically about \$90/kW).

Dissert. Abstr.

N76-26680 George Washington Univ., Washington, D.C.

THE ENERGY SYSTEM OF THE UNITED STATES Ph.D. Thesis

James Arthur White 1975 205 p

Avail: Univ. Microfilms Order No. 76-11258

Recent events have demonstrated the critical dependence of the economy of the United States on energy resources and have suggested the need for a precise definition of the components of the energy system and its expected future direction. The data necessary to define the composition of the energy system, the determinants of its performance, the future requirements for energy resources, and the factors which will affect the availability and use of these resources was developed. A methodology for integrating the data developed in the initial phase of the research

into energy balance for the period from 1975 to 2000 was found. Policies for the optimal management of the energy resources of the United States were formulated. Dissert. Abstr.

N76-26681 Stanford Univ., Calif.
LABORATORY STUDIES OF STIMULATED GEOTHERMAL RESERVOIRS Ph.D. Thesis
 Anstein Hunsbedt 1976 252 p
 Avail: Univ. Microfilms Order No. 76-13020

Improved recovery of geothermal energy from artificially stimulated systems by in-place flashing was studied experimentally. The laboratory model used produces steam from initial pressures and temperatures up to 800 psia (54.4 bar) and 500 F (260 C). Thermocouples were used to measure the steam temperature and the center temperature of rocks at various points in the rock matrix. Analytic solutions were derived for the rock thermal transients for comparison to measurements. Analytic models were developed for the model pressure and temperature transients based on mass and energy balances assuming uniform axial temperature distribution. The thermal characteristics of the laboratory model were determined from heatup and cooldown calibration experiments and from fluid production experiments with water only in the model. Results show that thermal energy stored in fractured rock can be extracted effectively by reducing system pressure to allow in-place flashing. Dissert. Abstr.

N76-26682# Committee on Interior and Insular Affairs (U. S. Senate).

GREATER COAL UTILIZATION, PART 3

Washington GPO 1975 1768 p refs Joint hearings on S. 1777 before Comm. on Interior and Insular Affairs and Comm. on Public Works, 94th Congr., 1st Sess., 1975 (GPO-55-305) Avail: Comm. on Interior and Insular Affairs

Joint hearings held before the Committees on Interior and Insular Affairs and Public Works of the U.S. Senate, dealing with greater coal utilization, were reported. These hearings were held in relation to proposed legislation requiring that new, and to the extent practicable, existing electric powerplant boilers and major industrial boilers utilizing fossil fuels should be capable of utilizing coal as their primary energy fuel in conformity with applicable environmental requirements, and for other purposes. The report consists primarily of communications submitted by utility companies, railways, and manufacturers of boilers and other equipment used for power generation. Y.J.A.

N76-26686* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A PRELIMINARY ASSESSMENT OF THE FEASIBILITY OF DERIVING LIQUID AND GASEOUS FUELS FROM GROWN AND WASTE ORGANICS

Robert W. Graham, Thaine W. Reynolds, and Yih-Yun Hsu 1976 9 p refs Presented at 11th Intersociety Energy Conversion Engr. Conf., State Line, Nev., 12-17 Sep. 1976 (NASA-TM-X-73441; E8463) Avail: NTIS HC \$3.50 CSCL 21D

The anticipated depletion of our resources of natural gas and petroleum in a few decades has caused a search for renewable sources of fuel. Among the possibilities is the chemical conversion of waste and grown organic matter into gaseous or liquid fuels. The overall feasibility of such a system is considered from the technical, economic, and social viewpoints. Although there are a number of difficult problems to overcome, this preliminary study indicates that this option could provide between 4 and 10 percent of the U.S. energy needs. Estimated costs of fuels derived from grown organic material are appreciably higher than today's market price for fossil fuel. The cost of fuel derived from waste organics is competitive with fossil fuel prices. Economic and social reasons will prohibit the allocation of good food producing land to fuel crop production. Author

N76-26690* National Aeronautics and Space Administration. Pasadena Office, Calif.

PORTABLE, LINEAR-FOCUSED SOLAR THERMAL ENERGY COLLECTING SYSTEM Patent Application

Charles G. Miller (JPL) and Jens G. Pohl, inventors (to NASA) (JPL) Filed 28 Apr. 1976 24 p Sponsored by NASA (NASA-Case-NPO-13734-1; US-Patent-Appl-SN-680939) Avail: NTIS HC \$3.50 CSCL 10A

A solar heat collection system is provided by utilizing a line focusing device that is effectively a cylindrically curved concentrator within a protected environment, formed by a transparent inflatable casing. A target, such as a fluid or gas carrying conduit is positioned within or near the casing containing the concentrator, at the line focus of the concentrator. The casing can be inflated at the site of use by a low pressure air supply to form a unitary light weight structure. When deflated, the collector is readily transportable. A system constructed from several line focusing devices can be used either at ground level or on rooftops. A system may advantageously utilize parallel aligned heat absorbing rigid conduits as targets, each conduit supporting an inflatable concentrator and casing. In particular cases the inflatable concentrator can be replaced with a rigid metal or other concentrator. NASA

N76-26691* National Aeronautics and Space Administration. Pasadena Office, Calif.

A SOLAR ENERGY COLLECTION SYSTEM Patent Application

M. Kudret Selcuk, inventor (to NASA) (JPL) Filed 28 Apr. 1976 18 p Sponsored by NASA (NASA-Case-NPO-13810-1; US-Patent-Appl-SN-681096) Avail: NTIS HC \$3.50 CSCL 10A

A solar energy collection system is described which includes several energy receivers supported in suspension by an array of radially extending booms. The receivers are suspended above a field of heliostats which serves to reflect beams of solar energy toward the receivers. Each of the receivers is characterized by a curved target surface substantially totally illuminated by the reflected beam. A network of interconnected conduits is included for conducting a working fluid along a tortuous path in juxtaposition with the target surface of each receiver. The working fluid is heated for converting radiant energy to heat, and a network of conduits collects and conducts the heated working fluid away from the receivers. NASA

N76-26695* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

IMPROVED LOW COST SUBSTRATES FOR POLYCRYSTALLINE LINE SOLAR CELLS Patent Application

Ting Lee Chu, inventor (to NASA) (Southern Methodist Univ.) Filed 4 Jun. 1976 40 p Sponsored by NASA (NASA-Case-GSC-12022-2; US-Patent-Appl-SN-693074) Avail: NTIS HC \$4.00 CSCL 10A

Low cost polycrystalline silicon solar cells supported on substrates are prepared by depositing successive layers of polycrystalline silicon containing appropriate dopants over supporting substrates. The substrates are selected from the group consisting of metallurgical-grade polycrystalline silicon, graphite, and steel coated with a diffusion barrier of silica, borosilicate, or phosphosilicate. Semiconductor p-n junction devices are formed which effectively convert solar energy to electrical energy. To improve the conversion efficiency of the polycrystalline silicon solar cells, the crystallite size in the silicon is substantially increased by melting and solidifying a base layer of polycrystalline silicon before depositing the layers which form the p-n junction. NASA

N76-26696# Committee on Agriculture and Forestry (U. S. Senate).

IMPACT OF ENERGY DECONTROL ON AGRICULTURE

Washington GPO 1975 60 p Hearing before Subcomm. on Agricultural Credit and Rural Electrification of Comm. on Agriculture and Forestry, 94th Congr., 1st Sess., 9 Sep. 1975 (GPO-39-102) Avail: Subcomm. on Agricultural Credit and Rural Electrification

The impact of the decontrol of petroleum on the food and agriculture sector is assessed in relation to the increased curtailments of natural gas supplies. Requirements of propane fuels for farm production needs as well as home heating needs are considered. J.M.S.

N76-26697# Committee on Government Operations (U. S. House).

SYNTHETIC GASOLINE

Washington GPO 1975 31 p Hearing before a subcomm. of the Comm. on Govt. Operations, 94th Congr., 1st Sess., 23 Sep. 1975

(GPO-59-975) Avail: Comm. on Govt. Operations

A method is described for producing synthetic benzene and its derivatives for use as major gasoline extenders. A feedstock material containing carbon (limestone has been used) is mixed with lithium metal in a stainless steel vessel, evacuated, and heated to 2,000 F. The molten metal attacks the carbon in the feedstock to form carbides, with a conversion efficiency of 90%. The material is then allowed to cool and water is added to form acetylene gas, which is catalyzed to form benzene with a conversion efficiency of almost 100%. The benzene is consistently pure; any sulfur or ash is left behind, regardless of the sulfur content of the feedstock material. Other feedstock materials considered are charcoal, coke, high sulfur coal and various types of organic wastes. The estimated cost of the product, using low grade coke or coal as the feedstock material, is \$15-\$20 per barrel. D.M.L.

N76-26698# Brookhaven National Lab., Upton, N.Y.

ERDA/NATIONAL LABORATORIES WORKSHOP ON ENVIRONMENTAL EFFECTS OF ENERGY

1975 141 p Workshop held at New York, 4-5 Sep. 1975

(Contract E(30-1)-16)

(BNL-20701) Avail: NTIS HC \$7.00

The important environmental impacts of energy production are summarized. A summary of these impacts associated with each step of the nuclear fuel cycle is included. ERA

N76-26699+ Energy Research and Development Administration, Washington, D.C.

WORLD ENERGY RESOURCES: AN ANNOTATED BIBLIOGRAPHY OF SELECTED MATERIAL ON THE AVAILABILITY AND DEVELOPMENT OF WORLD ENERGY RESOURCES

1975 21 p

(ERDA-53) Avail: NTIS HC \$4.50

The bibliography provides references to 173 recent English language publications covering the availability and development of world energy resources. Citations dealing exclusively with energy resources of the United States have been omitted. The references are sources of statistical and general energy policy information, not technical descriptions of resource development. Most of the items chosen (from books, journal articles, and reports) were published since 1972. The bibliography is divided into sections and within sections by year of publication and then alphabetically by title. The four general sections include citations that cover several types of energy resources in more than one country. Citations of energy resources in more than one country are given for coal, peat, oil shale, tar sands, petroleum, natural gas, geothermal hydraulics, nuclear energy, solar energy, ocean thermal gradients, tidal power, wind power, and wastes. ERA

N76-26700# Brookhaven National Lab., Upton, N.Y.

ENTHALPY MANAGEMENT IN BUILDINGS: AN ANALYSIS AND AN INTEGRATED APPROACH

A. L. Berlud, F. J. Salzano, and J. Batey Jul. 1975 47 p refs Sponsored by ERDA

(BNL-20572) Avail: NTIS HC \$5.45

Enthalpy management requirements of residential and small commercial buildings are analyzed, and integrated approaches to energy efficient and cost effective heating and cooling schemes are proposed. Improved design and operating strategies are suggested to make more efficient use of off-the-shelf (or other readily accessible) technology for space conditioning. Thermal storage devices, techniques, and special operational strategies are central to these approaches. Fossil fuel heaters, heat pumps, solar collectors, and electric driven air coolers, all can be used more efficiently when effectively interfaced with selected thermal storage systems. A central heated (fossil fuel) and cooled (electric air conditioner) residence located in Long Island, New York, is considered as an example. It is found that the revised operating approach leads to 50 percent savings in space conditioning costs, with the basic functional features of the building

unchanged, and assuming it is no better insulated than a typical well insulated frame residence. Additional insulation results in further savings. ERA

N76-26701# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY AND TECHNOLOGY REVIEW

R. B. Carr Dec. 1975 29 p refs

(Contract W-7405-eng-48)

(UCRL-52000-75-12) Avail: NTIS HC \$4.00

Brief discussions are given on research work at the National CTR Computer Center at Livermore, high-field superconducting magnets for fusion reactors, and digital image processing for plasma diagnostics. Some developmental work on multifilamentary superconductors of Nb-Ti and Nb-Sn is described. Some complex mathematical techniques for enhancing and restoring digital images for plasma diagnostics are discussed. NSA

N76-26702# Battelle Memorial Inst., Geneva (Switzerland). Research Centre.

EXPLORATORY STUDY OF HYDROGEN/SILVER OXIDE BATTERIES FOR SPACE APPLICATION Final Report [ETUDE EXPLORATOIRE CONCERNANT LES ACCUMULATEURS HYDROGENE-OXYDE D'ARGENT DESTINES A L'APPLICATION SPATIALE]

P. Jonville and F. Breda Oct. 1975 402 p refs In FRENCH (Contract ESTEC-2296/74-HP)

(ESA-CR(P)-781) Avail: NTIS HC \$11.00

To determine the applicability of the hydrogen/silver oxide system as electrical energy storage device for satellites and to investigate the problems involved when associating a metal oxide electrode to a gaseous diffusion electrode, the silver oxide/hydrogen couple performance was investigated. The operational mode of each constituent (hydrogen electrode, silver electrode) of the battery were studied, their characteristics evidenced and compared, and their compatibility analyzed. Performances and limitations of the hydrogen/silver oxide battery were assessed and compared to those of the H₂/NiOOH. The electrolyte, the separator, the container and its configuration, seals, and some specific problems such as thermal transfer are also reviewed. ESA

N76-26703# Minnesota Univ., Minneapolis.

RESEARCH APPLIED TO SOLAR-THERMAL POWER SYSTEMS Semiannual Report, 1 Jan. - 31 Aug. 1975

E. M. Sparrow, B. P. Gupta, and G. K. Wehner Sep. 1975 167 p refs Prepared in cooperation with Honeywell, Inc., Minneapolis, Minn. Sponsored in part by ERDA

(Grant NSF GI-34871)

(PB-248811/2; NSF/RANN/SE/GI-34871/P4-75-2;

NSF/RA/N-75-219; SAR-6) Avail: NTIS HC \$6.75 CSCL 10B

This project undertakes an integrated program of research and development focused on key technology of photothermal conversion for efficient use of solar energy in large-scale production of electricity. The report includes research and development on components of the system and heat transfer studies on system components. Experiments were continued on the scale model of a parabolic trough solar collector at a desert test site. A heat pipe with selective coating was replaced by a heat pipe coated with a flat black coating. Tests were performed with this absorber tube operating at temperatures up to 300 C. The effect of filling the space around the absorber tube with air was also studied. GRA

N76-26706# Oregon State Univ., Corvallis. Engineering Experiment Station.

FUTURE DEVELOPMENTS IN WASTE HEAT UTILIZATION

James G. Knudsen and Larry L. Boersma Aug. 1975 117 p refs Workshop held at Portland, Oreg., 16-17 Dec. 1974

(Grant NSF ENG-75-03338)

(PB-249346/8; OSU-EES-75-49C) Avail: NTIS HC \$5.50 CSCL 10A

The discussions and recommendations are summarized of a two-day industry-university-government conference on waste heat

utilization. Topic areas discussed include: future developments in waste heat utilization; constraints on efficient waste heat utilization; general problems in reject heat utilization; the agro-power-waste water complex; energy utilization in agriculture; using power plant discharge water in greenhouse vegetable production; use of waste heat for soil warming and frost protection of field crops in northern climates; beneficial uses of waste heat from power plants for aquaculture; biological recycling of nutrients from livestock wastes; and utilization of warm water for afforestation of the Snake River desert plain. GRA

N76-26707# Science Applications, Inc., McLean, Va.
BENEFIT-COST METHODOLOGY FOR EVALUATING ENERGY CONSERVATION PROGRAMS
Robert Lind and Robert Nathans Dec. 1975 107 p refs
(Contract FEA-CO-04-50120-00)
(PB-249342/7; SAI-75-523-WA; FEA/D-76/011) Avail: NTIS HC \$5.50 CSCL 10A

The basic concepts of benefit-cost analysis for conservation, and specific procedures for computing conservation benefits under different economic conditions are developed. This methodology is discussed as it applies to two major conservation options, the auto efficiency standard and home insulation. Using existing data, preliminary benefit-cost estimates are developed, and data requirements for improved estimation are discussed. GRA

N76-26708# Stanford Univ., Calif. High Temperature Gasdynamics Lab.
ATMOSPHERIC POLLUTION ASPECTS OF MAGNETOHYDRODYNAMIC POWER PLANTS Final Report
R. H. Eustis and C. H. Kruger Nov. 1975 20 p Sponsored by Elec. Power Inst.
(PB-248331/1; SU EPRI-110-FR) Avail: NTIS HC \$3.50 CSCL 10B

Research is described on the economics and emissions of nitric oxide of projected magnetohydrodynamic power plants. The research consisted of two parts, a system study and laboratory measurements. The systems study addressed the question of capital and operating cost of a coal burning MHD and the possibility of controlling potentially excessive emissions of nitric oxide. The systems study concluded that a MHD cycle has the potential for reduced operating costs in comparison with the conventional plant, and that nitric oxide emissions may be controlled by means of two-stage combustion. The laboratory measurements provided values for the dominant rates of NO decomposition in the temperature range of interest. These rates were incorporated in the analysis of the systems study. GRA

N76-26709# Texas Univ., Arlington. Inst. of Urban Studies.
A SECOND REPORT TO TEXAS CITIES CONCERNING ENERGY AND LOCAL GOVERNMENT, EXAMINING THE PRICE OF CRISIS: POLICY DEVELOPMENT FISCAL IMPACT

David W. MacKenna, Jacilyn Walker, and P. D. Creer, Jr. Jul. 1975 144 p refs
(PB-248849/2) Avail: NTIS HC \$6.00 CSCL 10A

A number of policy statements and legislative proposals at national as well as state levels are examined. Policy implications are suggested for the state of Texas with particular emphasis on local government. A process whereby city officials can contrast local energy costs with mean figures representing energy product expenses in the sample cities is discussed. GRA

N76-26710# Ultrasonics, Inc., Newport Beach, Calif.
A MARKET STUDY OF ENERGY-RELATED EQUIPMENTS FOR THE COMMERCIAL BUILDINGS SECTOR: DECISION-MAKERS, BUYING PROCESS, AND MARKETING STRATEGIES Final Report
19 Sep. 1975 155 p refs Sponsored by FEA
(Contract FEA-C-04-50202-00)
(PB-248618/1; FEA/D-76/010) Avail: NTIS HC \$6.75 CSCL 13A

Detailed information is provided about the market for conservation particles in the commercial buildings sector that may be stimulated or supported by federal government actions and initiatives. The commercial building sector, both existing and

projected through 1980, is described, and levels of energy consumption in each segment of the commercial buildings sector are listed. Key decision-makers involved in the buying and adoption process used for energy-related equipment, both new and retrofit are discussed. Existing market approaches, decision processes, areas of concentration for energy conservation, and recommendations for federal strategies to encourage energy conservation practices are covered. GRA

N76-26711# Dartmouth Coll., Hanover, N.H. Thayer School of Engineering.

MANAGING THE DISCOVERY LIFE CYCLE OF A FINITE RESOURCE: A CASE STUDY OF THE US NATURAL GAS INDUSTRY M.S. Thesis

Roger F. Naill Jun. 1972 146 p refs
(PB-248924/3; DSD-2; Dart-5) Avail: NTIS HC \$6.00 CSCL 05C

A system dynamics model of discovery of U.S. natural gas is developed as an example of the dynamics of the natural resource discovery process. It is indicated that in the case of finite, nonrenewable resources such as the fossil fuels, the normal behavior mode of the exploitation system is an initial period of exponential growth in consumption, then a period of rising prices where growth in consumption is halted, and finally a decline in consumption. The exact timing of the end of growth is determined by many factors, including the growth rate of potential usage, the initial level of unproven reserves, the shape of the cost-of-exploration curve, and the impact of various policies such as subsidies or ceiling price regulations. GRA

N76-27126# National Bureau of Standards, Washington, D.C.
DIMENSIONS/NBS, VOLUME 60, NUMBER 1, JANUARY 1976 Monthly Technical News Bulletin

Jan. 1976 24 p
(PB-248904-01; NBS/DIM-60/1; LC-25-26527) Avail: NTIS MF \$2.25; HC available from SOD CSCL 05B

A monthly magazine is examined which features short summaries of major technical developments, highlights of work in progress, major speeches and statements by The National Bureau of Standards management, and also a listing of National Bureau of Standards (NBS) publications. The table of contents for the current issue is: NBS develops new mercury monitor; An EPIC undertaking--out of the classroom, into the plant; Metal fires--science and safety; government primes the industrial pump; computer user's guide published by NBS; DOC-GSA cooperate in purchase of more efficient kitchen ranges; NBS makes computer network access easier; complete set of FIPS available from NBS; NBS, EPRI sign cooperative agreement on energy measurement technology; NBS establishes speakers bureau for metric information. GRA

N76-27464# Office of Telecommunications, Washington, D.C.
TELECOMMUNICATIONS SUBSTITUTABILITY FOR TRAVEL, AN ENERGY CONSERVATION POTENTIAL. APPENDIX A Final Report

Joseph R. Bewick Jan. 1975 150 p refs
(Contract DI-14-01-0001-2058)
(PB-249511/7; FEA/D-76/012) Avail: NTIS HC \$6.00 CSCL 17B

Telecommunications has the potential of conserving energy to a significant degree by substituting for the information handling functions currently being performed through the use of transportation. Two means of energy saving are explored: (1) decentralization of work forces, which would reduce commuter travel; and (2) the increased use of telecommunications by existing work forces in their current organizational structures. Energy consumption by telecommunications and transportation is explored as are the nature of the work forces and the factors influencing travel. Teleconferencing, both in the United States and abroad, is reviewed. GRA

N76-27516# + New Mexico Univ., Albuquerque. Technology Application Center.

HEAT PIPE TECHNOLOGY. A BIBLIOGRAPHY WITH ABSTRACTS Quarterly Update, 31 Dec. 1975

31 Dec. 1975 53 p Sponsored by NASA (NASA-CR-148320) Copyright. Avail: NTIS for foreign requesters only. Domestic orders, Univ. of New Mexico, Tech. Application Center, Albuquerque CSDL 20M

Heat Pipe Technology is a continuing bibliographic summary of research on the subject of the heat pipe. This update to Heat Pipe Technology cites the additional references identified during October, November and December of 1975. A library containing essentially all of the articles and publications referenced in this update, and all the previous volumes has been established. Author

N76-27668# Committee on Agriculture (U. S. House).

ENERGY REQUIREMENTS FOR FOOD AND FIBER

Washington GPO 1975 134 p refs Hearings before Subcomm. on Dept. Operations, Investigations and Oversight of Comm. on Agriculture, 94th Congr., 1st Sess., 17-18 Mar. 1975

(GPO-53-376) Avail: Subcomm. on Dept. Operations, Investigations and Oversight

Energy consumption for agriculture and related activities is considered. The provision of supplies for farms, farm production, processing, storage, distribution, marketing, and consumption are included. D.M.L.

N76-27669# Committee on Commerce (U. S. Senate).

NATURAL GAS PRODUCTION AND CONSERVATION ACT OF 1975

Washington GPO 1975 464 p refs Hearings before Comm. on Commerce, 94th Congr., 1st Sess., 17-18 Mar. 1975

(GPO-49-766) Avail: Comm. on Commerce

A bill is proposed which is designed to improve natural gas supplies while controlling inflation in natural gas prices. Price ceilings would be established with allowances for reasonable increases due to inflation or unusual circumstances. Producers on Federal lands would be required to develop and produce natural gas as soon as practicable. The bill would also ensure supplies to high priority users by prohibiting the use of natural gas when other fuels are satisfactory. Information regarding natural gas would also be made more available to the FPC and the public. D.M.L.

N76-27670# Committee on Science and Astronautics (U. S. House).

SECONDARY AND TERTIARY RECOVERY OF OIL

Joseph P. Riva, Jr. Washington GPO 1974 62 p refs Rept. for Subcomm. on Energy of Comm. on Sci. and Astron., 93d Congr., 2d Sess., Oct. 1974 Prepared by Library of Congr., Sci. Policy Res. Div.

(GPO-40-382) Avail: Subcomm. on Energy

Background information concerning the various oil recovery methods is presented. The geology associated with oil deposits is discussed and estimates of domestic oil reserves are given. Federal oil recovery research and development programs are considered in relation to the relevance of advanced oil recovery technology to the energy crisis. Author

N76-27672# Committee on Interior and Insular Affairs (U. S. Senate).

NATIONAL ENERGY PRODUCTION BOARD, PART 2

Washington GPO 1975 490 p refs Hearings on S. 740 before Comm. on Interior and Insular Affairs, 94th Congr., 1st Sess., 14 and 21 Jul. 1975

(GPO-57-639) Avail: Comm. on Interior and Insular Affairs

Legislation is presented which would establish a National Energy Production Board to assure early development of energy resources on the public domain and other Federal lands (i.e. Naval Petroleum Reserves) and on the outer continental shelf in order to overcome the dependence of the United States on foreign nations for energy supplies which are essential to national security, commerce, and a full-employment economy. The development of domestic fossil fuels is examined. The role of government and industry in the development of domestic oil

and natural gas is discussed. Federal budgets are outlined which would be used in the development of energy resources. Also considered is the development of coal resources and coal-fired electric power plants. J.R.T.

N76-27676# Brookhaven National Lab., Upton, N.Y. Engineering and Systems Div.

CONSERVATION AS A MAJOR ALTERNATIVE

K. C. Hoffman Oct. 1975 13 p refs Presented at the AT. Ind. Forum Workshop on the Nuclear Debate: Basic issues for 1976, Boston, 27-30 Oct., 1975 Sponsored by ERDA (BNL-20566; Conf-751055-2) Avail: NTIS HC \$4.50

Conservation is frequently viewed as an alternative to specific energy supply options such as nuclear power. Although it is not really a direct alternative to nuclear power, a strong conservation movement may reduce the level to which any specific supply options must be developed at a given future point in time. There are several important components to a conservation strategy, each of which may have different effects on the level of base load electric capacity, the prime market for nuclear power: these components are: (1) conservation of all energy forms; (2) conservation of scarce energy resources (oil and gas); and (3) conservation of power in the electric sector (by increasing the system load factor). With a general reduction of energy demands from all sources it is clear that less reliance need be placed on specific sources such as nuclear. There are also strong incentives, however, to place special emphasis on the conservation of scarce resources and on the improvement of electric load factors to conserve power. In these instances, there is an increased need for base-load electric generating facilities. Author (ERA)

N76-27677# Battelle Pacific Northwest Labs., Richland, Wash. **USER MANUAL FOR GEOCOST: A COMPUTER MODEL FOR GEOTHERMAL COST ANALYSIS. VOLUME 1: STEAM CYCLE VERSION**

H. D. Huber, C. H. Bloomster, and R. A. Walter Nov. 1975 145 p refs

(Contract E(45-1)-1830)

(BNWL-1942-Vol-1) Avail: NTIS HC \$7.00

A computer model called GEOCOST has been developed at Battelle, Pacific Northwest Laboratories, to rapidly and systematically calculate the potential costs of geothermal power. GEOCOST combines both technical processes and economic factors into one systematic framework and provides the flexibility to individually or collectively evaluate their economic impacts. The version of GEOCOST in this report simulates the production of electricity using a steam power conversion cycle based upon either a dry steam or hydrothermal resource. Future extensions to the model will simulate the production of electricity using other power conversion technologies, including binary fluid cycles, combined binary fluid cycles and steam, and the total flow concept. Author (ERA)

N76-27678# Battelle Pacific Northwest Labs., Richland, Wash. **TECHNOLOGY IN THE FUTURE: ENERGY**

L. C. Schmid 1975 6 p Conf. held in Richland, Washington, 8 Oct. 1974

(Contract E(45-1)-1830)

(BNWL-SA-5565; Conf-7410142-1) Avail: NTIS HC \$4.50

In creating long term solutions to the energy problem facing the U.S., the basic facts to consider are: (1) U.S. energy consumption is large and increasing rapidly, (2) less costly fuel supplies are running out, and (3) concern is growing for the social and environmental impact of energy generation, conversion, transportation and use. These factors are beginning to result in: (1) energy shortages, (2) increased costs, (3) growing dependence on foreign supplies, and (4) consideration of social and environmental aspects of energy production, as well as technical and economic ones. Independence of foreign oil and natural gas can be increased by conservation efforts, developing domestic supplies of oil and gas, and using more coal and uranium. For the longer term, renewable resources such as solar, geothermal, and fusion must be developed. World energy consumption, U.S. consumption, and consumption in the Pacific Northwest for 1970 were compared. ERA

N76-27679# Argonne National Lab., Ill.

HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE Progress Report, Jul. - Dec. 1973

P. A. Nelson, W. J. Walsh, R. K. Steunenbergh, J. E. Battles, H. Shimotake, N. P. Yao, H. C. Tsai, A. E. Martin, D. R. Vissers, J. R. Birk et al Nov. 1974 43 p refs

(Contract W-31-109-eng-38)

(ANL-8057) Avail: NTIS HC \$5.45

Development of high-specific-energy lithium/sulfur batteries for off-peak energy storage in electric utility networks is reported. The cells have negative electrodes of solid lithium-aluminum alloy, positive electrodes of iron sulfide (FeS₂ or FeS), with an electrolyte of molten LiCl-KCl eutectic (mp. 352 C). The operating temperature of the cells is about 400 C. An engineering-scale (13-cm-dia) cell was operated for 1,390 hr and has attained a specific energy of 121 W-hr/kg. The use of iron sulfide positive electrodes has extended the capacity retention and cycle life of the cells. The major areas of experimental work in the program are design and scale-up of individual sealed cells, development of electrodes, testing of materials of construction and fabrication of cell components, and supporting laboratory studies.

Author (ERA)

N76-27681# Minnesota Univ., Minneapolis.

RESEARCH APPLIED TO SOLAR THERMAL POWER SYSTEMS Progress Report, 1 Jan. - 31 Aug. 1975

E. M. Sparrow, B. P. Gupta, and G. K. Wehner 30 Sep. 1975 167 p refs Prepared in cooperation with Honeywell, Inc., Minneapolis, Minn. Sponsored in part by ERDA

(Grant NSF GI-34871)

(NSF/RANN/SE/GI-34871/PR-75-2; Rept-6) Avail: NTIS HC \$7.75

Experiments were conducted on a scale model parabolic trough collector module in which the heat pipe absorber tube was coated with a non-selective black paint. The collector efficiency was found to be significantly lower than with a selectively coated absorber tube. Second surface aluminum and silver mirrors on Acrylic, Teflon, and glass demonstrated negligible degradation from exposure periods exceeding two years; Auger Electron Spectroscopy and in situ sputtering were used for determining composition versus depth profiles of different solar absorber coatings. Heat pipe tests relating the effect of inclination angle and materials compatibility were performed. An experimental boiler/heat exchanger was operated and the stream and feedwater flow rates were measured as well as the pressure and temperature in the boiler. Thermal conductivity measurements of insulating materials were also performed. The heat transfer characteristics of phase-change heat storage media were calculated, and experience was obtained with a single-phase (water) heat storage system.

Author (ERA)

N76-27682# Hawaii Univ., Honolulu. Inst. of Geophysics.

GEOELECTRIC-GEOTHERMAL EXPLORATION ON HAWAII ISLAND: PRELIMINARY RESULTS

D. P. Klein and J. P. Kaahikaua Jan. 1975 33 p refs Sponsored by ERDA

(HIG-75-6) Avail: NTIS HC \$4.50

Geoelectric reconnaissance surveys were performed on Hawaii Island to locate areas of low resistivity that might have the potential for commercial geothermal development. The lower northeast end of the Kilauea East Rift Zone has low resistivities (less than 10 ohm-m) that indicate anomalous geothermal conditions. Preliminary results of both ac and dc resistivity surveys indicate that the most promising zone of high temperature waters is at depths of 500 to 1,500 meters beneath the 1955 eruptive vents in this region. The temperature in this zone may be as great as 200 C. Further analysis is continuing on the data and additional data are being gathered to attempt to outline the probable extent of the material with low resistivity. Author (ERA)

N76-27683# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.

CATALOG ON SOLAR ENERGY HEATING AND COOLING PRODUCTS

Oct. 1975 445 p refs

(ERDA-75) Avail: NTIS HC \$12.75

A quick reference to products that are specifically designed for use in conversion or control of solar energy into useful energy for domestic water heating, space heating, space heating and cooling and industrial process heat. Intended for use by manufacturers of components and subsystems to identify each other for the purpose of offering systems; by architectural and engineering firms to select products; and by users and owners to locate products. The contents are restricted to those products that are currently being manufactured or are in advanced stages of development leading to near term manufacturing within the United States.

ERA

N76-27684# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.

DIESEL FUEL OILS, 1975

E. M. Shelton Nov. 1975 40 p refs

(BERC/PPS-75/3) Avail: NTIS HC \$4.00

The analyses of the fuels are listed in tables for four groups according to type of diesel fuel. Each group of analyses is subdivided into five tabulations according to five general regions of the country where the fuels are marketed. The regions, containing a total of 16 districts, are shown on a map. A total of 13 laboratory tests are listed and arranged by geographic marketing districts in decreasing order of sales volumes. Charts are included showing trends of averages of certain properties for the four types of diesel fuels for the years 1960 to 1975. Summaries of the results of the 1975 survey, compared with similar data for 1974, are shown.

Author (ERA)

N76-27685# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.

FEDERAL WIND ENERGY PROGRAM, SUMMARY REPORT

Oct. 1975 83 p

(ERDA-84) Avail: NTIS HC \$5.45

This paper presents a brief overview of the federal research and development activities in the field of wind energy and includes abstracts of the individual projects which comprise the program.

Author (ERA)

N76-27686# Dow Chemical Co., Midland, Mich.

SOLAR ENERGY SUBSYSTEMS EMPLOYING ISOTHERMAL HEAT SINK MATERIALS Semiannual Progress Report, 18 Sep. 1974 - 31 Jun. 1975

G. A. Lane, J. S. Best, E. C. Clarke, S. S. Drake, D. N. Glew, S. W. Quigley, and H. E. Rossow Jul. 1975 25 p refs Supported in part by ERDA

(Contract NSF C-906)

(TID-26907) Avail: NTIS HC \$4.50

A group of over 200 potential phase change heat storage materials, melting from 10 to 90 C was identified. Laboratory tests narrowed these to materials recommended for hot faucet water, hydronic heating, forced air heating, heat pump application, radiant wall panels, and stored cold systems. Several encapsulation methods were studied: micro-encapsulation, encapsulation of powders and granules, and macro-encapsulation. Micro-encapsulation of CaCl₂·GH₂O in polyester resin has been successful, and development of wall, floor, and ceiling panels is under way. Macro-encapsulation in plastic film containers appears promising for hot air systems.

Author (ERA)

N76-27687# California Univ., Livermore. Lawrence Livermore Lab.

GEOTHERMAL BINARY FLUID CYCLE: HEAT EXCHANGER AREA REQUIREMENTS AND INITIAL COSTS

W. H. Giedt 23 Sep. 1975 27 p refs

(Contract W-7405-eng-48)

(UCRL-51912) Avail: NTIS HC \$4.50

The basic elements of a geothermal binary-fluid energy-conversion cycle are reviewed and the possible different sequences of states of the secondary or working fluid are discussed. The most efficient sequence, thermodynamically, is shown to be when this fluid remains in the compressed liquid and supercritical states during heating and expands to a saturated vapor during the work output process. Such a cycle is independent of the particular working fluid used and can be considered an upper bound of

the performance that can be achieved with a specified brine inlet temperature. System performance is then only a function of the temperatures of the brine and working fluid leaving the exchanger. Assuming the use of a counterflow heat exchanger, with the working fluid following the supercritical cycle described, determining the optimum operating condition for the system is shown to require combined consideration of the heat-exchanger and energy-conversion-cycle performances. Author (ERA)

N76-27688# California Univ., Livermore. Lawrence Livermore Lab.

GEOHERMAL PROJECT DESCRIPTION: LLL EXPERIMENTAL SITE SALTON SEA GEOHERMAL FIELD

T. D. Palmer and D. F. Towse 7 Nov. 1975 17 p refs

(Contract W-7405-eng-48)

(UCID-16951) Avail: NTIS HC \$4.00

The Lawrence Livermore Laboratory program for geothermal research requires the development of a field experimental facility in order to conduct a series of tests on turbine prototypes and to analyze the system requirements for power conversion. This report gives a description of the field portion of this experimental program including site development, test activities, and project administration. Additionally, it discusses plans for concurrent field environmental studies and surveillance programs. A series of maps are included to describe land ownership and lease status within the area of interest. Successful completion of the test program will prove the technology necessary for commercial development. An assessment of environmental factors indicates few temporary and no long term adverse environmental effects from this program. Author (ERA)

N76-27689# Sandia Labs., Albuquerque, N.Mex.

SANDIA MAGMA ENERGY RESEARCH PROJECT

J. L. Colp 1975 25 p refs Presented at the 2d United Nations Symp. on the Develop. and Uses of Geothermal Resources. San Francisco, 20-29 May 1975

(SAND-75-5492; Conf-750525-3) Avail: NTIS HC \$4.25

The objective of this project is to perform the basic research and development studies needed to locate and define the potential resources, and to provide the materials technology and engineering concepts required to produce clean, high quality energy from subsurface magma bodies. It will be implemented in four general areas: (1) source location and definition, (2) source tapping, (3) magma/material compatibilities, and (4) energy extraction.

Author (ERA)

N76-27690# Energy Research and Development Administration, Oak Ridge, Tenn.

ENERGY IN PERSPECTIVE

J. H. Hill and F. C. Huffman 1975 26 p refs Sponsored by ERDA

(TID-26900) Avail: NTIS HC \$5.00

Increasing energy requirements are based on increasing populations and in the U.S., with a fourfold population increase since 1900, total energy consumption has increased fourteen fold. World data for energy per capita consumption, 1968, vs gross national product per capita are graphically compared. Energy sources and their end uses in the U.S. are summarized. Most energy sources for the future require technological development or demonstration to be considered for large blocks of power. The fast breeder reactor, solar energy, oil shales, liquefaction and gasification of coal, fusion reactors, hydrogen, geothermal energy, oil from tar sands, combustion and gasification of waste, superconducting solenoids, flywheels, the wind, the ocean tides, and thermal gradients in the oceans or large lakes are potential energy sources cited. The environmental impact from the winning and use of energy sources is described and may be mitigated through conservation. ERA

N76-27694# Argonne National Lab., Ill.

SITE: A METHODOLOGY FOR ASSESSMENT OF ENERGY FACILITY SITING PATTERNS. REGIONAL STUDIES PROGRAM

N. A. Frigerio, L. J. Habegger, R. F. King, L. J. Hoover, N. A. Clark, and J. M. Cobian Aug. 1975 116 p refs

(Contract W-31-109-eng-38)

(ANL/AA-2) Avail: NTIS HC \$5.45

A documentation is presented of the computerized SITE methodology that was developed for evaluating health, environmental, and socioeconomic impacts related to utilization of alternate sites for energy production within a region of interest. The cost, impact, and attribute vectors, which are generated and displayed on density maps, can be used in a multiparameter overlay process to identify preferable siting areas. The assessment of clustered facilities in energy centers is also possible within the SITE analysis framework. An application of the SITE methodology to Northern Illinois is presented. Also included is a description of the on-going extension of SITE for the accumulative evaluation of alternative regional siting patterns and fuel cycle options. An appendix provides documentation and user information for the SITE computer program. Author (NSA)

N76-27699# Metropolitan Transportation Authority, Inc., New York.

ENERGY STORAGE PROPULSION SYSTEM FOR RAPID TRANSIT CARS. SYSTEM DESIGN AND EQUIPMENT DESCRIPTION

Donald Raskin and Ronald T. Yutko Sep. 1975 52 p Sponsored in part by N. Y. State Dept. of Transportation and AirResearch Mfg. Co., Torrance, Calif.

(Grant DOT-UT-550)

(PB-249063/9; UMTA-NY-06-0006-75-1)

Avail: NTIS

HC \$4.50 CSCL 10C

When a transit rail car accelerates, it draws energy from a wayside electric power source; when it decelerates, the car must ride itself of this energy. Conventional rail cars dissipate this energy in the form of heat. A transit car propulsion system is described which will save much of this presently wasted energy by storing the car's kinetic energy in flywheels which are mounted below the car floor. The stored energy is then available for the subsequent acceleration of the car. Thus a significant reduction in energy usage is expected, along with a resultant reduction in subway tunnel heating. This energy storage propulsion system has been installed on two New York City subway cars and will be subjected to an extensive series of tests. GRA

N76-27700# Hittman Associates, Inc., Columbia, Md.

A STUDY OF THE PHYSICAL CHARACTERISTICS, ENERGY CONSUMPTION, AND RELATED INSTITUTIONAL FACTORS IN THE COMMERCIAL SECTOR Final Report

Harvey M. Bernstein and Patrick M. McCarthy Dec. 1975 199 p refs

(Contract FEA-C-04-51888-00)

(PB-249470/6; HIT-630; FEA/D-76/053)

Avail: NTIS

HC \$7.50 CSCL 13A

Specific areas addressed in the report are: physical characteristics of existing commercial buildings in Baltimore, Maryland and Denver, Colorado; energy consumption of existing buildings in Baltimore; institutional factors related to constructing and/or operating more energy efficient commercial buildings; policy options and their feasibility for inducing energy conservation through retrofit. GRA

N76-27701# Gordian Associates, Inc., New York.

OPPORTUNITIES AND INCENTIVES FOR ELECTRIC UTILITY LOAD MANAGEMENT Final Report

Apr. 1975 324 p refs

(Contract DI-14-01-0001-1842)

(PB-249348/4; FEA/D-75/528; FEA/D-CP-32)

Avail: NTIS

HC \$9.75 CSCL 10B

The option of improved load management is seen as one solution to the crisis facing the utility industry and its consumers today. Load management has as its objective the achievement of a more optimum pattern of demand on distribution, transmission, and generation equipment so as to result in a more optimum utilization of all the scarce resources which are consumed in meeting demand. The study concludes that: (1) improved load management can effectively contribute to the conservation of scarce primary energy resources through satisfaction of the overall

load with a more efficient mix of generating units; (2) improved load management can minimize the escalation of rates and alleviate the financial difficulties of investor-owned utilities by reducing requirements for capital equipment and by ensuring that incremental revenues match incremental costs. GRA

N76-27702# Gordian Associates, Inc., New York.
UCAN MANUAL OF CONSERVATION MEASURES Final Report

Nov. 1975 194 p refs
 (Contract FEA-C-04-50235-00)
 (PB-249343/5; FEA/D-CP-628; FEA/D-CP-35) Avail: NTIS HC \$7.50 CSCL 10A

Efforts undertaken by individual utilities and regulatory agencies demonstrate the feasibility and effectiveness of a wide range of conservation measures. The underlying principles and estimated energy conservation potential of conservation measures are presented. Specific implementation strategies are discussed, while the practical experience gained by utility companies by carrying out these conservation measures is documented. GRA

N76-27703# Federal Energy Administration, Washington, D.C.
 Office of Energy Conservation and Environment.

GUIDE TO ENERGY CONSERVATION FOR FOOD SERVICE

Oct. 1975 83 p
 (PB-249462/3; FEA/D-75/411) Avail: NTIS HC \$5.00 CSCL 06H

Energy-saving suggestions for all types of food service operations are provided. Energy conservation steps are identified for food preparation and storage, lighting, heating, ventilating, and air conditioning, and sanitation. The potential for savings are listed, with emphasis placed on increasing the efficiency of presently used equipment. Detailed steps to enable a food service manager to chart his fuel usage and monthly energy consumption, and to analyze the results of his conservation efforts are given. GRA

N76-27704# Federal Energy Administration, Washington, D.C.
 Office of Energy Conservation and Environment.

ENERGY CONSERVATION POTENTIAL OF URBAN MASS TRANSIT

Mayo S. Stuntz, Jr. and Eric Hirst Dec. 1975 33 p refs
 (PB-249336/9; FEA/D-75/621; Conservation-Paper-34) Avail: NTIS HC \$4.00 CSCL 10A

Urban travel and its energy use are examined. The relative energy intensiveness of different automobile and transit services, recent experiments with improved transit service, and possible future energy impacts of expanded and improved transit are discussed. GRA

N76-28113# Porsche (Ferdinand) AG, Stuttgart (West Germany).
UTILIZATION OF BRAKE ENERGY IN INDIVIDUAL VEHICLES FOR REDUCTION OF CONSUMPTION AND EXHAUST EMISSION Final Report [NUTZUNG DER BREMSENERGIE IN INDIVIDUALFAHRZEUGEN ZUR VERBRAUCHSUND ABGASEMISSIONSMINDERUNG]

Fritz Hartig and Reinhard Hofmann Bonn Bundesmin. fuer Forsch. u. Technol. Dec. 1975 187 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.
 (BMFT-FB-T-75-38) Avail: NTIS HC \$7.50; ZLDI, Munich DM 39,30

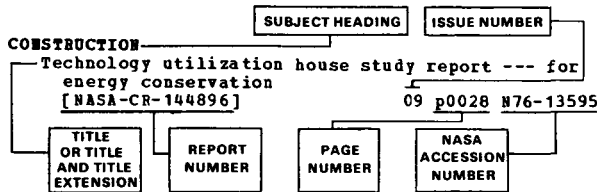
The possibilities of hybrid drives for brake energy utilization are explained in view of the energy shortage. Expenditure for and utility of the brake energy utilization are compared by means of selected drives and appropriate vehicles based on the principles of driving mechanics as well as of storage and conversion techniques. Despite an undeniable reduction of consumption, economical reasons oppose the general introduction of this system into series production. In special applications, such as taxis and buses etc., the regenerative brake may be useful. Author (ESA)

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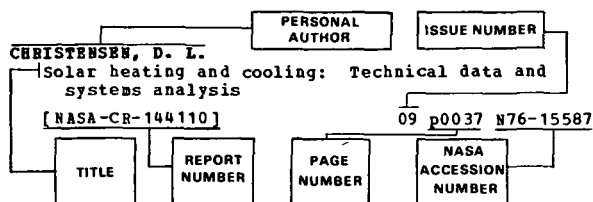
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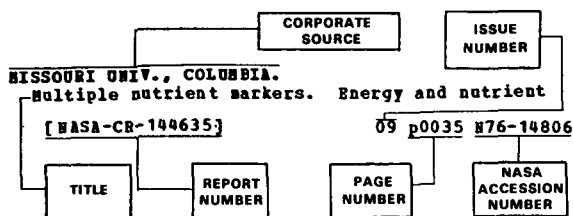
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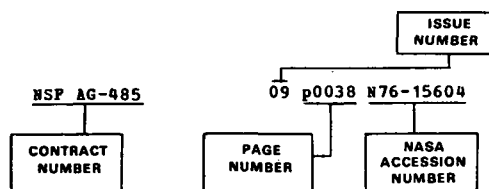
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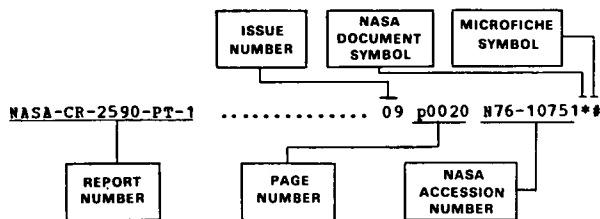
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